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(21) International Application Number: PCT/US00/05432 (22) International Filing Date: 2 March 2000 (02.03.00) (30) Priority Data: 60/122,389 2 March 1999 (02.03.99) US 60/126,049 23 March 1999 (23.03.99) US 60/136,744 28 May 1999 (28.05.99) US (71) Applicant: LIFE TECHNOLOGIES, INC. [US/US]; 9800 Medical Center Drive, Rockville, MD 20850 (US). (72) Inventors: HARTLEY, James, L.; 7409 Hillside Drive, Frederick, MD 21702 (US). BRASCH, Michael, A.; 20931 Sunnycres Road, Gaithersburg, MD 20882 (US). TEMPLE, Gary, F.; 114 Ridge Road, Washington Grove, MD 20882 (US). CHEO, David; 2006 Baltimore Road, #21, Rockville, MD 20851 (US). (74) Agents: ESMOND, Robert, W. et al.; Sterne, Kessler, Goldstein & Fox P.L.L.C., Suite 600, 1100 New York Avenue, N.W., Washington, DC 20005-3934 (US).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>With an indication in relation to deposited biological material furnished under Rule 13bis separately from the description.</i>
(54) Title: COMPOSITIONS AND METHODS FOR USE IN RECOMBINATIONAL CLONING OF NUCLEIC ACIDS		
(57) Abstract The present invention relates generally to compositions and methods for use in recombinational cloning of nucleic acid molecules. In particular, the invention relates to nucleic acid molecules encoding one or more recombination sites or portions thereof, to nucleic acid molecules comprising one or more of these recombination site nucleotide sequences and optionally comprising one or more additional physical or functional nucleotide sequences. The invention also relates to vectors comprising the nucleic acid molecules of the invention, to host cells comprising the vectors or nucleic acid molecules of the invention, to methods of producing polypeptides using the nucleic acid molecules of the invention, and to polypeptides encoded by these nucleic acid molecules or produced by the methods of the invention. The invention also relates to antibodies that bind to one or more polypeptides of the invention or epitopes thereof. The invention also relates to the use of these compositions in methods for recombinational cloning of nucleic acids, <i>in vitro</i> and <i>in vivo</i> , to provide chimeric DNA molecules that have particular characteristics and/or DNA segments.		

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Compositions and Methods for Use in Recombinational Cloning of Nucleic Acids

5 BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to recombinant DNA technology.

10 More particularly, the present invention relates to compositions and methods for use in recombinational cloning of nucleic acid molecules. The invention relates specifically to nucleic acid molecules encoding one or more recombination sites or one or more partial recombination sites, particularly *attB*, *attP*, *attL*, and *attR*, and fragments, mutants, variants and derivatives thereof. The invention also
15 relates to such nucleic acid molecules wherein the one or more recombination site nucleotide sequences is operably linked to the one or more additional physical or functional nucleotide sequences. The invention also relates to vectors comprising the nucleic acid molecules of the invention, to host cells comprising the vectors or nucleic acid molecules of the invention, to methods of producing polypeptides and RNAs encoded by the nucleic acid molecules of the invention, and to
20 polypeptides encoded by these nucleic acid molecules or produced by the methods of the invention, which may be fusion proteins. The invention also relates to antibodies that bind to one or more polypeptides of the invention or epitopes thereof, which may be monoclonal or polyclonal antibodies. The invention also
25 relates to the use of these nucleic acid molecules, vectors, polypeptides and antibodies in methods for recombinational cloning of nucleic acids, *in vitro* and *in vivo*, to provide chimeric DNA molecules that have particular characteristics and/or DNA segments. More particularly, the antibodies of the invention may be used to identify and/or purify proteins or fusion proteins encoded by the nucleic
30 acid molecules or vectors of the invention, or to identify and/or purify the nucleic acid molecules of the invention.

Related Art

Site-specific recombinases. Site-specific recombinases are proteins that are present in many organisms (e.g. viruses and bacteria) and have been characterized to have both endonuclease and ligase properties. These recombinases (along with associated proteins in some cases) recognize specific sequences of bases in DNA and exchange the DNA segments flanking those segments. The recombinases and associated proteins are collectively referred to as "recombination proteins" (see, e.g., Landy, A., *Current Opinion in Biotechnology* 3:699-707 (1993)).

Numerous recombination systems from various organisms have been described. See, e.g., Hoess *et al.*, *Nucleic Acids Research* 14(6):2287 (1986); Abremski *et al.*, *J. Biol. Chem.* 261(1):391 (1986); Campbell, *J. Bacteriol.* 174(23):7495 (1992); Qian *et al.*, *J. Biol. Chem.* 267(11):7794 (1992); Araki *et al.*, *J. Mol. Biol.* 225(1):25 (1992); Maeser and Kahnmann *Mol. Gen. Genet.* 230:170-176 (1991); Esposito *et al.*, *Nucl. Acids Res.* 25(18):3605 (1997).

Many of these belong to the integrase family of recombinases (Argos *et al.* *EMBO J.* 5:433-440 (1986); Voziyanov *et al.*, *Nucl. Acids Res.* 27:930 (1999)). Perhaps the best studied of these are the Integrase/*att* system from bacteriophage λ (Landy, A. *Current Opinions in Genetics and Devel.* 3:699-707 (1993)), the Cre/*loxP* system from bacteriophage P1 (Hoess and Abremski (1990) In *Nucleic Acids and Molecular Biology*, vol. 4. Eds.: Eckstein and Lilley, Berlin-Heidelberg: Springer-Verlag; pp. 90-109), and the FLP/FRT system from the *Saccharomyces cerevisiae* 2 μ circle plasmid (Broach *et al.* *Cell* 29:227-234 (1982)).

Backman (U.S. Patent No. 4,673,640) discloses the *in vivo* use of λ recombinase to recombine a protein producing DNA segment by enzymatic site-specific recombination using wild-type recombination sites *attB* and *attP*.

Hasan and Szybalski (*Gene* 56:145-151 (1987)) discloses the use of λ Int recombinase *in vivo* for intramolecular recombination between wild type *attP* and *attB* sites which flank a promoter. Because the orientations of these sites are

inverted relative to each other, this causes an irreversible flipping of the promoter region relative to the gene of interest.

Palazzolo *et al.* *Gene* 88:25-36 (1990), discloses phage lambda vectors having bacteriophage λ arms that contain restriction sites positioned outside a cloned DNA sequence and between wild-type *loxP* sites. Infection of *E. coli* cells that express the Cre recombinase with these phage vectors results in recombination between the *loxP* sites and the *in vivo* excision of the plasmid replicon, including the cloned cDNA.

Pósfai *et al.* (*Nucl. Acids Res.* 22:2392-2398 (1994)) discloses a method for inserting into genomic DNA partial expression vectors having a selectable marker, flanked by two wild-type FRT recognition sequences. FLP site-specific recombinase as present in the cells is used to integrate the vectors into the genome at predetermined sites. Under conditions where the replicon is functional, this cloned genomic DNA can be amplified.

Bebee *et al.* (U.S. Patent No. 5,434,066) discloses the use of site-specific recombinases such as Cre for DNA containing two *loxP* sites for *in vivo* recombination between the sites.

Boyd (*Nucl. Acids Res.* 21:817-821 (1993)) discloses a method to facilitate the cloning of blunt-ended DNA using conditions that encourage intermolecular ligation to a dephosphorylated vector that contains a wild-type *loxP* site acted upon by a Cre site-specific recombinase present in *E. coli* host cells.

Waterhouse *et al.* (WO 93/19172 and *Nucleic Acids Res.* 21 (9):2265 (1993)) disclose an *in vivo* method where light and heavy chains of a particular antibody were cloned in different phage vectors between *loxP* and *loxP 511* sites and used to transfect new *E. coli* cells. Cre, acting in the host cells on the two parental molecules (one plasmid, one phage), produced four products in equilibrium: two different cointegrates (produced by recombination at either *loxP* or *loxP 511* sites), and two daughter molecules, one of which was the desired product.

Schlake & Bode (*Biochemistry* 33:12746-12751 (1994)) discloses an *in vivo* method to exchange expression cassettes at defined chromosomal locations, each flanked by a wild type and a spacer-mutated FRT recombination site. A

double-reciprocal crossover was mediated in cultured mammalian cells by using this FLP/FRT system for site-specific recombination.

Hartley *et al.* (U.S. Patent No. 5,888,732) disclose compositions and methods for recombinational exchange of nucleic acid segments and molecules, including for use in recombinational cloning of a variety of nucleic acid molecules *in vitro* and *in vivo*, using a combination of wildtype and mutated recombination sites and recombination proteins.

Transposases. The family of enzymes, the transposases, has also been used to transfer genetic information between replicons. Transposons are structurally variable, being described as simple or compound, but typically encode the recombinase gene flanked by DNA sequences organized in inverted orientations. Integration of transposons can be random or highly specific. Representatives such as Tn7, which are highly site-specific, have been applied to the *in vivo* movement of DNA segments between replicons (Lucklow *et al.*, *J. Virol.* 67:4566-4579 (1993)).

Devine and Boeke *Nucl. Acids Res.* 22:3765-3772 (1994), discloses the construction of artificial transposons for the insertion of DNA segments, *in vitro*, into recipient DNA molecules. The system makes use of the integrase of yeast TY1 virus-like particles. The DNA segment of interest is cloned, using standard methods, between the ends of the transposon-like element TY1. In the presence of the TY1 integrase, the resulting element integrates randomly into a second target DNA molecule.

Recombination Sites. Also key to the integration/recombination reactions mediated by the above-noted recombination proteins and/or transposases are recognition sequences, often termed "recombination sites," on the DNA molecules participating in the integration/recombination reactions. These recombination sites are discrete sections or segments of DNA on the participating nucleic acid molecules that are recognized and bound by the recombination proteins during the initial stages of integration or recombination. For example, the recombination site for Cre recombinase is *loxP* which is a 34 base pair sequence comprised of two 13 base pair inverted repeats (serving as the recombinase binding sites) flanking an 8 base pair core sequence. See Figure 1 of Sauer, B., *Curr. Opin. Biotech.*

5:521-527 (1994). Other examples of recognition sequences include the *attB*,
attP, *attL*, and *attR* sequences which are recognized by the recombination protein
 λ Int. *attB* is an approximately 25 base pair sequence containing two 9 base pair
core-type Int binding sites and a 7 base pair overlap region, while *attP* is an
5 approximately 240 base pair sequence containing core-type Int binding sites and
arm-type Int binding sites as well as sites for auxiliary proteins integration host
factor (IHF), FIS and excisionase (Xis). See Landy, *Curr. Opin. Biotech.*
3:699-707 (1993); see also U.S. Patent No. 5,888,732, which is incorporated by
reference herein.

10 **DNA cloning.** The cloning of DNA segments currently occurs as a daily
routine in many research labs and as a prerequisite step in many genetic analyses.
The purpose of these clonings is various, however, two general purposes can be
considered: (1) the initial cloning of DNA from large DNA or RNA segments
(chromosomes, YACs, PCR fragments, mRNA, etc.), done in a relative handful
15 of known vectors such as pUC, pGem, pBlueScript, and (2) the subcloning of
these DNA segments into specialized vectors for functional analysis. A great deal
of time and effort is expended both in the transfer of DNA segments from the
initial cloning vectors to the more specialized vectors. This transfer is called
subcloning.

20 The basic methods for cloning have been known for many years and have
changed little during that time. A typical cloning protocol is as follows:

- (1) digest the DNA of interest with one or two restriction enzymes;
- (2) gel purify the DNA segment of interest when known;
- (3) prepare the vector by cutting with appropriate restriction
25 enzymes, treating with alkaline phosphatase, gel purify etc., as
appropriate;
- (4) ligate the DNA segment to the vector, with appropriate
controls to eliminate background of uncut and self-ligated vector;
- (5) introduce the resulting vector into an *E. coli* host cell;
- (6) pick selected colonies and grow small cultures overnight;
- 30 (7) make DNA minipreps; and

(8) analyze the isolated plasmid on agarose gels (often after diagnostic restriction enzyme digestions) or by PCR.

The specialized vectors used for subcloning DNA segments are functionally diverse. These include but are not limited to: vectors for expressing nucleic acid molecules in various organisms; for regulating nucleic acid molecule expression; for providing tags to aid in protein purification or to allow tracking of proteins in cells; for modifying the cloned DNA segment (*e.g.*, generating deletions); for the synthesis of probes (*e.g.*, riboprobes); for the preparation of templates for DNA sequencing; for the identification of protein coding regions; for the fusion of various protein-coding regions; to provide large amounts of the DNA of interest, *etc.* It is common that a particular investigation will involve subcloning the DNA segment of interest into several different specialized vectors.

As known in the art, simple subclonings can be done in one day (*e.g.*, the DNA segment is not large and the restriction sites are compatible with those of the subcloning vector). However, many other subclonings can take several weeks, especially those involving unknown sequences, long fragments, toxic genes, unsuitable placement of restriction sites, high backgrounds, impure enzymes, *etc.* Subcloning DNA fragments is thus often viewed as a chore to be done as few times as possible.

Several methods for facilitating the cloning of DNA segments have been described, *e.g.*, as in the following references.

Ferguson, J., *et al. Gene* 16:191 (1981), discloses a family of vectors for subcloning fragments of yeast DNA. The vectors encode kanamycin resistance. Clones of longer yeast DNA segments can be partially digested and ligated into the subcloning vectors. If the original cloning vector conveys resistance to ampicillin, no purification is necessary prior to transformation, since the selection will be for kanamycin.

Hashimoto-Gotoh, T., *et al. Gene* 41:125 (1986), discloses a subcloning vector with unique cloning sites within a streptomycin sensitivity gene; in a streptomycin-resistant host, only plasmids with inserts or deletions in the dominant sensitivity gene will survive streptomycin selection.

Accordingly, traditional subcloning methods, using restriction enzymes and ligase, are time consuming and relatively unreliable. Considerable labor is expended, and if two or more days later the desired subclone can not be found among the candidate plasmids, the entire process must then be repeated with alternative conditions attempted. Although site specific recombinases have been used to recombine DNA *in vivo*, the successful use of such enzymes *in vitro* was expected to suffer from several problems. For example, the site specificities and efficiencies were expected to differ *in vitro*; topologically linked products were expected; and the topology of the DNA substrates and recombination proteins was expected to differ significantly *in vitro* (see, e.g., Adams *et al*, *J. Mol. Biol.* 226:661-73 (1992)). Reactions that could go on for many hours *in vivo* were expected to occur in significantly less time *in vitro* before the enzymes became inactive. In addition, the stabilities of the recombination enzymes after incubation for extended periods of time in *in vitro* reactions was unknown, as were the effects of the topologies (*i.e.*, linear, coiled, supercoiled, etc.) of the nucleic acid molecules involved in the reaction. Multiple DNA recombination products were expected in the biological host used, resulting in unsatisfactory reliability, specificity or efficiency of subcloning. Thus, *in vitro* recombination reactions were not expected to be sufficiently efficient to yield the desired levels of product.

Accordingly, there is a long felt need to provide an alternative subcloning system that provides advantages over the known use of restriction enzymes and ligases.

SUMMARY OF THE INVENTION

The present invention relates to nucleic acid molecules encoding one or more recombination sites or one or more partial recombination sites, particularly *attB*, *attP*, *attL*, and *attR*, and fragments, mutants, variants and derivatives thereof. The invention also relates to such nucleic acid molecules comprising one or more of the recombination site nucleotide sequences or portions thereof and one or more additional physical or functional nucleotide sequences, such as those

encoding one or more multiple cloning sites, one or more transcription termination sites, one or more transcriptional regulatory sequences (*e.g.*, one or more promoters, enhancers, or repressors), one or more translational signal sequences, one or more nucleotide sequences encoding a fusion partner protein or peptide (*e.g.*, GST, His₆ or thioredoxin), one or more selection markers or modules, one or more nucleotide sequences encoding localization signals such as nuclear localization signals or secretion signals, one or more origins of replication, one or more protease cleavage sites, one or more desired proteins or peptides encoded by a gene or a portion of a gene, and one or more 5' or 3' polynucleotide tails (particularly a poly-G tail). The invention also relates to such nucleic acid molecules wherein the one or more recombination site nucleotide sequences is operably linked to the one or more additional physical or functional nucleotide sequences.

The invention also relates to primer nucleic acid molecules comprising the recombination site nucleotide sequences of the invention (or portions thereof), and to such primer nucleic acid molecules linked to one or more target-specific (*e.g.*, one or more gene-specific) primer nucleic acid sequences. Such primers may also comprise sequences complementary or homologous to DNA or RNA sequences to be amplified, *e.g.*, by PCR, RT-PCR, etc. Such primers may also comprise sequences or portions of sequences useful in the expression of protein genes (ribosome binding sites, localization signals, protease cleavage sites, repressor binding sites, promoters, transcription stops, stop codons, etc.). Said primers may also comprise sequences or portions of sequences useful in the manipulation of DNA molecules (restriction sites, transposition sites, sequencing primers, etc.). The primers of the invention may be used in nucleic acid synthesis and preferably are used for amplification (*e.g.*, PCR) of nucleic acid molecules. When the primers of the invention include target- or gene-specific sequences (any sequence contained within the target to be synthesized or amplified including translation signals, gene sequences, stop codons, transcriptional signals (*e.g.*, promoters) and the like), amplification or synthesis of target sequences or genes may be accomplished. Thus, the invention relates to synthesis of a nucleic acid molecules comprising mixing one or more primers of the invention with a nucleic acid

template, and incubating said mixture under conditions sufficient to make a first nucleic acid molecule complementary to all or a portion of said template. Thus, the invention relates specifically to a method of synthesizing a nucleic acid molecule comprising:

- 5 (a) mixing a nucleic acid template with a polypeptide having polymerase activity and one or more primers comprising one or more recombination sites or portions thereof; and
- (b) incubating said mixture under conditions sufficient to synthesize a first nucleic acid molecule complementary to all or a portion of said
- 10 template and which preferably comprises one or more recombination sites or portions thereof.

Such method of the invention may further comprise incubating said first synthesized nucleic acid molecule under conditions sufficient to synthesize a second nucleic acid molecule complementary to all or a portion of said first nucleic acid molecule. Such synthesis may provide for a first nucleic acid molecule having

15 a recombination site or portion thereof at one or both of its termini.

In a preferred aspect, for the synthesis of the nucleic acid molecules, at least two primers are used wherein each primer comprises a homologous sequence at its terminus and/or within internal sequences of each primer (which may have

20 a homology length of about 2 to about 500 bases, preferably about 3 to about 100 bases, about 4 to about 50 bases, about 5 to about 25 bases and most preferably about 6 to about 18 base overlap). In a preferred aspect, the first such primer comprises at least one target-specific sequence and at least one recombination site or portion thereof while the second primer comprises at least one recombination

25 site or portion thereof. Preferably, the homologous regions between the first and second primers comprise at least a portion of the recombination site. In another aspect, the homologous regions between the first and second primers may comprise one or more additional sequences, *e.g.*, expression signals, translational start motifs, or other sequences adding functionality to the desired nucleic acid sequence upon amplification. In practice, two pairs of primers prime synthesis or

30 amplification of a nucleic acid molecule. In a preferred aspect, all or at least a portion of the synthesized or amplified nucleic acid molecule will be homologous

to all or a portion of the template and further comprises a recombination site or a portion thereof at at least one terminus and preferably both termini of the synthesized or amplified molecule. Such synthesized or amplified nucleic acid molecule may be double stranded or single stranded and may be used in the recombination cloning methods of the invention. The homologous primers of the invention provide a substantial advantage in that one set of the primers may be standardized for any synthesis or amplification reaction. That is, the primers providing the recombination site sequences (without the target specific sequences) can be pre-made and readily available for use. This in practice allows the use of shorter custom made primers that contain the target specific sequence needed to synthesize or amplify the desired nucleic acid molecule. Thus, this provides reduced time and cost in preparing target specific primers (e.g., shorter primers containing the target specific sequences can be prepared and used in synthesis reactions). The standardized primers, on the other hand, may be produced in mass to reduce cost and can be readily provided (e.g., in kits or as a product) to facilitate synthesis of the desired nucleic acid molecules.

Thus, in one preferred aspect, the invention relates to a method of synthesizing or amplifying one or more nucleic acid molecules comprising:

- (a) mixing one or more nucleic acid templates with at least one polypeptide having polymerase or reverse transcriptase activity and at least a first primer comprising a template specific sequence (complementary to or capable of hybridizing to said templates) and at least a second primer comprising all or a portion of a recombination site wherein said at least a portion of said second primer is homologous to or complementary to at least a portion of said first primer; and
- (b) incubating said mixture under conditions sufficient to synthesize or amplify one or more nucleic acid molecules complementary to all or a portion of said templates and comprising one or more recombination sites or portions thereof at one and preferably both termini of said molecules.

More specifically, the invention relates to a method of synthesizing or amplifying one or more nucleic acid molecules comprising:

- 5 (a) mixing one or more nucleic acid templates with at least one polypeptide having polymerase or reverse transcriptase activity and at least a first primer comprising a template specific sequence (complementary to or capable of hybridizing to said templates) and at least a portion of a recombination site, and at least a second primer comprising all or a portion of a recombination site wherein said at least a portion of said recombination site on said second primer is complementary to or homologous to at least a portion of said recombination site on said first primer; and
- 10 (b) incubating said mixture under conditions sufficient to synthesize or amplify one or more nucleic acid molecules complementary to all or a portion of said templates and comprising one or more recombination sites or portions thereof at one and preferably both termini of said molecules.
- 15

In a more preferred aspect, the invention relates to a method of amplifying or synthesizing one or more nucleic acid molecules comprising:

- 20 (a) mixing one or more nucleic acid templates with at least one polypeptide having polymerase or reverse transcriptase activity and one or more first primers comprising at least a portion of a recombination site and a template specific sequence (complementary to or capable of hybridizing to said template);
- 25 (b) incubating said mixture under conditions sufficient to synthesize or amplify one or more first nucleic acid molecules complementary to all or a portion of said templates wherein said molecules comprise at least a portion of a recombination site at one and preferably both termini of said molecules;
- 30 (c) mixing said molecules with one or more second primers comprising one or more recombination sites, wherein said recombination sites of said second primers are homologous to or

complementary to at least a portion of said recombination sites on said first nucleic acid molecules; and

- (d) incubating said mixture under conditions sufficient to synthesize or amplify one or more second nucleic acid molecules complementary to all or a portion of said first nucleic acid molecules and which comprise one or more recombination sites at one and preferably both termini of said molecules.

The invention also relates to vectors comprising the nucleic acid molecules of the invention, to host cells comprising the vectors or nucleic acid molecules of the invention, to methods of producing polypeptides encoded by the nucleic acid molecules of the invention, and to polypeptides encoded by these nucleic acid molecules or produced by the methods of the invention, which may be fusion proteins. The invention also relates to antibodies that bind to one or more polypeptides of the invention or epitopes thereof, which may be monoclonal or polyclonal antibodies. The invention also relates to the use of these nucleic acid molecules, primers, vectors, polypeptides and antibodies in methods for recombinational cloning of nucleic acids, *in vitro* and *in vivo*, to provide chimeric DNA molecules that have particular characteristics and/or DNA segments.

The antibodies of the invention may have particular use to identify and/or purify peptides or proteins (including fusion proteins produced by the invention), and to identify and/or purify the nucleic acid molecules of the invention or portions thereof.

The methods for *in vitro* or *in vivo* recombinational cloning of nucleic acid molecule generally relate to recombination between at least a first nucleic acid molecule having at least one recombination site and a second nucleic acid molecule having at least one recombination site to provide a chimeric nucleic acid molecule. In one aspect, the methods relate to recombination between and first vector having at least one recombination site and a second vector having at least one recombination site to provide a chimeric vector. In another aspect, a nucleic acid molecule having at least one recombination site is combined with a vector having at least one recombination site to provide a chimeric vector. In a most preferred aspect, the nucleic acid molecules or vectors used in recombination

comprise two or more recombination sites. In a more specific embodiment of the invention, the recombination methods relate to a Destination Reaction (also referred to herein as an "LR reaction") in which recombination occurs between an Entry clone and a Destination Vector. Such a reaction transfers the nucleic acid molecule of interest from the Entry Clone into the Destination Vector to create an Expression Clone. The methods of the invention also specifically relate to an Entry or Gateward reaction (also referred to herein as a "BP reaction") in which an Expression Clone is recombined with a Donor vector to produce an Entry clone. In other aspects, the invention relates to methods to prepare Entry clones by combining an Entry vector with at least one nucleic acid molecule (e.g., gene or portion of a gene). The invention also relates to conversion of a desired vector into a Destination Vector by including one or more (preferably at least two) recombination sites in the vector of interest. In a more preferred aspect, a nucleic acid molecule (e.g., a cassette) having at least two recombination sites flanking a selectable marker (e.g., a toxic gene or a genetic element preventing the survival of a host cell containing that gene or element, and/or preventing replication, partition or heritability of a nucleic acid molecule (e.g., a vector or plasmid) comprising that gene or element) is added to the vector to make a Destination Vector of the invention.

Preferred vectors for use in the invention include prokaryotic vectors, eukaryotic vectors, or vectors which may shuttle between various prokaryotic and/or eukaryotic systems (e.g. shuttle vectors). Preferred prokaryotic vectors for use in the invention include but are not limited to vectors which may propagate and/or replicate in gram negative and/or gram positive bacteria, including bacteria of the genera *Escherichia*, *Salmonella*, *Proteus*, *Clostridium*, *Klebsiella*, *Bacillus*, *Streptomyces*, and *Pseudomonas* and preferably in the species *E. coli*. Eukaryotic vectors for use in the invention include vectors which propagate and/or replicate in yeast cells, plant cells, mammalian cells, (particularly human and mouse), fungal cells, insect cells, nematode cells, fish cells and the like. Particular vectors of interest include but are not limited to cloning vectors, sequencing vectors, expression vectors, fusion vectors, two-hybrid vectors, gene therapy vectors, phage display vectors, gene-targeting vectors, PACs, BACs, YACs, MACs, and

reverse two-hybrid vectors. Such vectors may be used in prokaryotic and/or eukaryotic systems depending on the particular vector.

In another aspect, the invention relates to kits which may be used in carrying out the methods of the invention, and more specifically relates to cloning or subcloning kits and kits for carrying out the LR Reaction (*e.g.*, making an Expression Clone), for carrying out the BP Reaction (*e.g.*, making an Entry Clone), and for making Entry Clone and Destination Vector molecules of the invention. Such kits may comprise a carrier or receptacle being compartmentalized to receive and hold therein any number of containers. Such containers may contain any number of components for carrying out the methods of the invention or combinations of such components. In particular, a kit of the invention may comprise one or more components (or combinations thereof) selected from the group consisting of one or more recombination proteins or auxiliary factors or combinations thereof, one or more compositions comprising one or more recombination proteins or auxiliary factors or combinations thereof (for example, GATEWAY™ LR Clonase™ Enzyme Mix or GATEWAY™ BP Clonase™ Enzyme Mix), one or more reaction buffers, one or more nucleotides, one or more primers of the invention, one or more restriction enzymes, one or more ligases, one or more polypeptides having polymerase activity (*e.g.*, one or more reverse transcriptases or DNA polymerases), one or more proteinases (*e.g.*, proteinase K or other proteinases), one or more Destination Vector molecules, one or more Entry Clone molecules, one or more host cells (*e.g.* competent cells, such as *E. coli* cells, yeast cells, animal cells (including mammalian cells, insect cells, nematode cells, avian cells, fish cells, etc.), plant cells, and most particularly *E. coli* DB3.1 host cells, such as *E. coli* LIBRARY EFFICIENCY® DB3.1™ Competent Cells), instructions for using the kits of the invention (*e.g.*, to carry out the methods of the invention), and the like. In related aspects, the kits of the invention may comprise one or more nucleic acid molecules encoding one or more recombination sites or portions thereof, particularly one or more nucleic acid molecules comprising a nucleotide sequence encoding the one or more recombination sites or portions thereof of the invention. Preferably, such nucleic acid molecules comprise at least two recombination sites which flank a selectable

marker (*e.g.*, a toxic gene and/or antibiotic resistance gene). In a preferred aspect, such nucleic acid molecules are in the form of a cassette (*e.g.*, a linear nucleic acid molecule comprising one or more and preferably two or more recombination sites or portions thereof).

5 Kits for inserting or adding recombination sites to nucleic acid molecules of interest may comprise one or more nucleases (preferably restriction endonucleases), one or more ligases, one or more topoisomerases, one or more polymerases, and one or more nucleic acid molecules or adapters comprising one or more recombination sites. Kits for integrating recombination sites into one or
10 more nucleic acid molecules of interest may comprise one or more components (or combinations thereof) selected from the group consisting of one or more integration sequences comprising one or more recombination sites. Such integration sequences may comprise one or more transposons, integrating viruses, homologous recombination sequences, RNA molecules, one or more host cells
15 and the like.

 Kits for making the Entry Clone molecules of the invention may comprise any or a number of components and the composition of such kits may vary depending on the specific method involved. Such methods may involve inserting the nucleic acid molecules of interest into an Entry or Donor Vector by the
20 recombinational cloning methods of the invention, or using conventional molecular biology techniques (*e.g.*, restriction enzyme digestion and ligation). In a preferred aspect, the Entry Clone is made using nucleic acid amplification or synthesis products. Kits for synthesizing Entry Clone molecules from amplification or synthesis products may comprise one or more components (or combinations
25 thereof) selected from the group consisting of one or more Donor Vectors (*e.g.*, one or more attP vectors including, but not limited to, pDONR201 (Figure 49), pDONR202 (Figure 50), pDONR203 (Figure 51), pDONR204 (Figure 52), pDONR205 (Figure 53), pDONR206 (Figure 53), and the like), one or more polypeptides having polymerase activity (preferably DNA polymerases and most preferably thermostable DNA polymerases), one or more proteinases, one or more
30 reaction buffers, one or more nucleotides, one or more primers comprising one or

more recombination sites or portions thereof, and instructions for making one or more Entry Clones.

Kits for making the Destination vectors of the invention may comprise any number of components and the compositions of such kits may vary depending on the specific method involved. Such methods may include the recombination methods of the invention or conventional molecular biology techniques (e.g., restriction endonuclease digestion and ligation). In a preferred aspect, the Destination vector is made by inserting a nucleic acid molecule comprising at least one recombination site (or portion thereof) of the invention (preferably a nucleic acid molecule comprising at least two recombination sites or portions thereof flanking a selectable marker) into a desired vector to convert the desired vector into a Destination vector of the invention. Such kits may comprise at least one component (or combinations thereof) selected from the group consisting of one or more restriction endonucleases, one or more ligases, one or more polymerases, one or more nucleotides, reaction buffers, one or more nucleic acid molecules comprising at least one recombination site or portion thereof (preferably at least one nucleic acid molecule comprising at least two recombination sites flanking at least one selectable marker, such as a cassette comprising at least one selectable marker such as antibiotic resistance genes and/or toxic genes), and instructions for making such Destination vectors.

The invention also relates to kits for using the antibodies of the invention in identification and/or isolation of peptides and proteins (which may be fusion proteins) produced by the nucleic acid molecules of the invention, and for identification and/or isolation of the nucleic acid molecules of the invention or portions thereof. Such kits may comprise one or more components (or combination thereof) selected from the group consisting of one or more antibodies of the invention, one or more detectable labels, one or more solid supports and the like.

Other preferred embodiments of the present invention will be apparent to one of ordinary skill in light of what is known in the art, in light of the following drawings and description of the invention, and in light of the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts one general method of the present invention, wherein the starting (parent) DNA molecules can be circular or linear. The goal is to exchange the new subcloning vector D for the original cloning vector B. It is desirable in one embodiment to select for AD and against all the other molecules, including the Cointegrate. The square and circle are sites of recombination: *e.g.*, *lox* (such as *loxP*) sites, *att* sites, *etc.* For example, segment D can contain expression signals, protein fusion domains, new drug markers, new origins of replication, or specialized functions for mapping or sequencing DNA. It should be noted that the cointegrate molecule contains Segment D (Destination vector) adjacent to segment A (Insert), thereby juxtaposing functional elements in D with the insert in A. Such molecules can be used directly in vitro (*e.g.*, if a promoter is positioned adjacent to a gene-for in vitro transcription/translation) or in vivo (following isolation in a cell capable of propagating *ccdB*-containing vectors) by selecting for the selection markers in Segments B+D. As one skilled in the art will recognize, this single step method has utility in certain envisioned applications of the invention.

Figure 2 is a more detailed depiction of the recombinational cloning system of the invention, referred to herein as the "GATEWAY™ Cloning System." This figure depicts the production of Expression Clones via a "Destination Reaction," which may also be referred to herein as an "LR Reaction." A *kan^r* vector (referred to herein as an "Entry clone") containing a DNA molecule of interest (*e.g.*, a gene) localized between an *attL1* site and an *attL2* site is reacted with an *amp^r* vector (referred to herein as a "Destination Vector") containing a toxic or "death" gene localized between an *attR1* site and an *attR2* site, in the presence of GATEWAY™ LR Clonase™ Enzyme Mix (a mixture of Int, IHF and Xis). After incubation at 25°C for about 60 minutes, the reaction yields an *amp^r* Expression Clone containing the DNA molecule of interest localized between an *attB1* site and an *attB2* site, and a *kan^r* byproduct molecule, as well as intermediates. The reaction mixture may then be transformed into host cells (*e.g.*, *E. coli*) and clones containing the nucleic acid molecule of interest may

be selected by plating the cells onto ampicillin-containing media and picking amp^r colonies.

Figure 3 is a schematic depiction of the cloning of a nucleic acid molecule from an Entry clone into multiple types of Destination vectors, to produce a variety of Expression Clones. Recombination between a given Entry clone and different types of Destination vectors (not shown), via the LR Reaction depicted in Figure 2, produces multiple different Expression Clones for use in a variety of applications and host cell types.

Figure 4 is a detailed depiction of the production of Entry Clones via a "BP reaction," also referred to herein as an "Entry Reaction" or a "Gateway Reaction." In the example shown in this figure, an amp^r expression vector containing a DNA molecule of interest (*e.g.*, a gene) localized between an *attB1* site and an *attB2* site is reacted with a kan^r Donor vector (*e.g.*, an *attP* vector; here, GATEWAY™ pDONR201 (see Figure 49A-C)) containing a toxic or "death" gene localized between an *attP1* site and an *attP2* site, in the presence of GATEWAY™ BP Clonase™ Enzyme Mix (a mixture of Int and IHF). After incubation at 25°C for about 60 minutes, the reaction yields a kan^r Entry clone containing the DNA molecule of interest localized between an *attL1* site and an *attL2* site, and an amp^r by-product molecule. The Entry clone may then be transformed into host cells (*e.g.*, *E. coli*) and clones containing the Entry clone (and therefore the nucleic acid molecule of interest) may be selected by plating the cells onto kanamycin-containing media and picking kan^r colonies. Although this figure shows an example of use of a kan^r Donor vector, it is also possible to use Donor vectors containing other selection markers, such as the gentamycin resistance or tetracycline resistance markers, as discussed herein.

Figure 5 is a more detailed schematic depiction of the LR ("Destination") reaction (Figure 5A) and the BP ("Entry" or "Gateway") reaction (Figure 5B) of the GATEWAY™ Cloning System, showing the reactants, products and byproducts of each reaction.

Figure 6 shows the sequences of the attB1 and attB2 sites flanking a gene of interest after subcloning into a Destination Vector to create an Expression Clone.

Figure 7 is a schematic depiction of four ways to make Entry Clones using the compositions and methods of the invention: 1. using restriction enzymes and ligase; 2. starting with a cDNA library prepared in an attL Entry Vector; 3. using an Expression Clone from a library prepared in an attB Expression Vector via the BxP reaction; and 4. recombinational cloning of PCR fragments with terminal attB sites, via the BxP reaction. Approaches 3 and 4 rely on recombination with a Donor vector (here, an attP vector such as pDONR201 (see Figure 49A-C), pDONR202 (see Figure 50A-C), pDONR203 (see Figure 51A-C), pDONR204 (see Figure 52A-C), pDONR205 (see Figure 53A-C), or pDONR206 (see Figure 54A-C), for example) that provides an Entry Clone carrying a selection marker such as kan^r, gen^r, tet^r, or the like.

Figure 8 is a schematic depiction of cloning of a PCR product by a BxP (Entry or Gateward) reaction. A PCR product with 25 bp terminal attB sites (plus four Gs) is shown as a substrate for the BxP reaction. Recombination between the attB-PCR product of a gene and a Donor vector (which donates an Entry Vector that carries kan^r) results in an Entry Clone of the PCR product.

Figure 9 is a listing of the nucleotide sequences of the recombination sites designated herein as *attB1*, *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* and *attR2*. Sequences are written conventionally, from 5' to 3'.

Figures 10-20: The plasmid backbone for all the Entry Vectors depicted herein is the same, and is shown in Figure 10A for the Entry Vector pENTR1A. For other Entry Vectors shown in Figures 11-20, only the sequences shown in Figure "A" for each figure set (*i.e.*, Figure 11A, Figure 12A, etc.) are different (within the attL1-attL2 cassettes) from those shown in Figure 10 -- the plasmid backbone is identical.

Figure 10 is a schematic depiction of the physical map and cloning sites (Figure 10A), and the nucleotide sequence (Figure 10B), of the Entry Vector pENTR1A.

Figure 11 is a schematic depiction of the cloning sites (Figure 11A) and the nucleotide sequence (Figure 11B) of the Entry Vector pENTR2B.

Figure 12 is a schematic depiction of the cloning sites (Figure 12A) and the nucleotide sequence (Figure 12B) of the Entry Vector pENTR3C.

5 **Figure 13** is a schematic depiction of the cloning sites (Figure 13A) and the nucleotide sequence (Figure 13B) of the Entry Vector pENTR4.

Figure 14 is a schematic depiction of the cloning sites (Figure 14A) and the nucleotide sequence (Figure 14B) of the Entry Vector pENTR5.

10 **Figure 15** is a schematic depiction of the cloning sites (Figure 15A) and the nucleotide sequence (Figure 15B) of the Entry Vector pENTR6.

Figure 16 is a schematic depiction of the cloning sites (Figure 16A) and the nucleotide sequence (Figure 16B) of the Entry Vector pENTR7.

Figure 17 is a schematic depiction of the cloning sites (Figure 17A) and the nucleotide sequence (Figure 17B) of the Entry Vector pENTR8.

15 **Figure 18** is a schematic depiction of the cloning sites (Figure 18A) and the nucleotide sequence (Figure 18B) of the Entry Vector pENTR9.

Figure 19 is a schematic depiction of the cloning sites (Figure 19A) and the nucleotide sequence (Figure 19B) of the Entry Vector pENTR10.

20 **Figure 20** is a schematic depiction of the cloning sites (Figure 20A) and the nucleotide sequence (Figure 20B) of the Entry Vector pENTR11.

25 **Figure 21** is a schematic depiction of the physical map and the Trc expression cassette (Figure 21A) showing the promoter sequences at -35 and at -10 from the initiation codon, and the nucleotide sequence (Figure 21B-D), of Destination Vector pDEST1. This vector may also be referred to as pTrc-DEST1.

30 **Figure 22** is a schematic depiction of the physical map and the His6 expression cassette (Figure 22A) showing the promoter sequences at -35 and at -10 from the initiation codon, and the nucleotide sequence (Figure 22B-D), of Destination Vector pDEST2. This vector may also be referred to as pHis6-DEST2.

Figure 23 is a schematic depiction of the physical map and the GST expression cassette (Figure 23A) showing the promoter sequences at -35 and at -10 from the initiation codon, and the nucleotide sequence (Figure 23B-D), of Destination Vector pDEST3. This vector may also be referred to as pGST-DEST3.

Figure 24 is a schematic depiction of the physical map and the His6-Trx expression cassette (Figure 24A) showing the promoter sequences at -35 and at -10 from the initiation codon and a TEV protease cleavage site, and the nucleotide sequence (Figure 24B-D), of Destination Vector pDEST4. This vector may also be referred to as pTrx-DEST4.

Figure 25 is a schematic depiction of the attR1 and attR2 sites (Figure 25A), the physical map (Figure 25B), and the nucleotide sequence (Figure 25C-D), of Destination Vector pDEST5. This vector may also be referred to as pSPORT(+)-DEST5.

Figure 26 is a schematic depiction of the attR1 and attR2 sites (Figure 26A), the physical map (Figure 26B), and the nucleotide sequence (Figure 26C-D), of Destination Vector pDEST6. This vector may also be referred to as pSPORT(-)-DEST6.

Figure 27 is a schematic depiction of the attR1 site, CMV promoter, and the physical map (Figure 27A), and the nucleotide sequence (Figure 27B-C), of Destination Vector pDEST7. This vector may also be referred to as pCMV-DEST7.

Figure 28 is a schematic depiction of the attR1 site, baculovirus polyhedrin promoter, and the physical map (Figure 28A), and the nucleotide sequence (Figure 28B-D), of Destination Vector pDEST8. This vector may also be referred to as pFastBac-DEST8.

Figure 29 is a schematic depiction of the attR1 site, Semliki Forest Virus promoter, and the physical map (Figure 29A), and the nucleotide sequence (Figure 29B-E), of Destination Vector pDEST9. This vector may also be referred to as pSFV-DEST9.

Figure 30 is a schematic depiction of the attR1 site, baculovirus polyhedrin promoter, His6 fusion domain, and the physical map (Figure 30A), and the nucleotide sequence (Figure 30B-D), of Destination Vector pDEST10. This vector may also be referred to as pFastBacHT-DEST10.

Figure 31 is a schematic depiction of the attR1 cassette containing a tetracycline-regulated CMV promoter and the physical map (Figure 31A), and the nucleotide sequence (Figure 31B-D), of Destination Vector pDEST11. This vector may also be referred to as pTet-DEST11.

Figure 32 is a schematic depiction of the attR1 site, the start of the mRNA of the CMV promoter, and the physical map (Figure 32A), and the nucleotide sequence (Figure 32B-D), of Destination Vector pDEST12.2. This vector may also be referred to as pCMVneo-DEST12, as pCMV-DEST12, or as pDEST12.

Figure 33 is a schematic depiction of the attR1 site, the λP_L promoter, and the physical map (Figure 33A), and the nucleotide sequence (Figure 33B-C), of Destination Vector pDEST13. This vector may also be referred to as $p\lambda P_L$ -DEST13.

Figure 34 is a schematic depiction of the attR1 site, the T7 promoter, and the physical map (Figure 34A), and the nucleotide sequence (Figure 34B-D), of Destination Vector pDEST14. This vector may also be referred to as pT7-DEST14.

Figure 35 is a schematic depiction of the attR1 site, the T7 promoter, and the N-terminal GST fusion sequence, and the physical map (Figure 35A), and the nucleotide sequence (Figure 35B-D), of Destination Vector pDEST15. This vector may also be referred to as pT7 GST-DEST15.

Figure 36 is a schematic depiction of the attR1 site, the T7 promoter, and the N-terminal thioredoxin fusion sequence, and the physical map (Figure 36A), and the nucleotide sequence (Figure 36B-D), of Destination Vector pDEST16. This vector may also be referred to as pT7 Trx-DEST16.

Figure 37 is a schematic depiction of the attR1 site, the T7 promoter, and the N-terminal His6 fusion sequence, and the physical map (Figure 37A), and the

nucleotide sequence (Figure 37B-D), of Destination Vector pDEST17. This vector may also be referred to as pT7 His-DEST17.

5 **Figure 38** is a schematic depiction of the attR1 site and the p10 baculovirus promoter, and the physical map (Figure 38A), and the nucleotide sequence (Figure 38B-D), of Destination Vector pDEST18. This vector may also be referred to as pFBp10-DEST18.

10 **Figure 39** is a schematic depiction of the attR1 site, and the 39k baculovirus promoter, and the physical map (Figure 39A), and the nucleotide sequence (Figure 39B-D), of Destination Vector pDEST19. This vector may also be referred to as pFB39k-DEST19.

15 **Figure 40** is a schematic depiction of the attR1 site, the *polh* baculovirus promoter, and the N-terminal GST fusion sequence, and the physical map (Figure 40A), and the nucleotide sequence (Figure 40B-D), of Destination Vector pDEST20. This vector may also be referred to as pFB GST-DEST20.

20 **Figure 41** is a schematic depiction of a 2-hybrid vector with a DNA-binding domain, the attR1 site, and the ADH promoter, and the physical map (Figure 41A), and the nucleotide sequence (Figure 41B-E), of Destination Vector pDEST21. This vector may also be referred to as pDB Leu-DEST21.

25 **Figure 42** is a schematic depiction of a 2-hybrid vector with an activation domain, the attR1 site, and the ADH promoter, and the physical map (Figure 42A), and the nucleotide sequence (Figure 42B-D), of Destination Vector pDEST22. This vector may also be referred to as pPC86-DEST22.

30 **Figure 43** is a schematic depiction of the attR1 and attR2 sites, the T7 promoter, and the C-terminal His6 fusion sequence, and the physical map (Figure 43A), and the nucleotide sequence (Figure 43B-D), of Destination Vector pDEST23. This vector may also be referred to as pC-term-His6-DEST23.

35 **Figure 44** is a schematic depiction of the attR1 and attR2 sites, the T7 promoter, and the C-terminal GST fusion sequence, and the physical map (Figure 44A), and the nucleotide sequence (Figure 44B-D), of Destination Vector pDEST24. This vector may also be referred to as pC-term-GST-DEST24.

Figure 45 is a schematic depiction of the attR1 and attR2 sites, the T7 promoter, and the C-terminal thioredoxin fusion sequence, and the physical map (Figure 45A), and the nucleotide sequence (Figure 45B-D), of Destination Vector pDEST25. This vector may also be referred to as pC-term-Trx-DEST25.

5 **Figure 46** is a schematic depiction of the attR1 site, the CMV promoter, and an N-terminal His6 fusion sequence, and the physical map (Figure 46A), and the nucleotide sequence (Figure 46B-D), of Destination Vector pDEST26. This vector may also be referred to as pCMV-SPneo-His-DEST26.

10 **Figure 47** is a schematic depiction of the attR1 site, the CMV promoter, and an N-terminal GST fusion sequence, and the physical map (Figure 47A), and the nucleotide sequence (Figure 47B-D), of Destination Vector pDEST27. This vector may also be referred to as pCMV-Spneo-GST-DEST27.

15 **Figure 48** is a depiction of the physical map (Figure 48A), the cloning sites (Figure 48B), and the nucleotide sequence (Figure 48C-D), for the attB cloning vector plasmid pEXP501. This vector may also be referred to equivalently herein as pCMV-SPORT6, pCMVSPORT6, and pCMVSpport6.

20 **Figure 49** is a depiction of the physical map (Figure 49A), and the nucleotide sequence (Figure 49B-C), for the Donor plasmid pDONR201 which donates a kanamycin-resistant vector in the BP Reaction. This vector may also be referred to as pAttPkanr Donor Plasmid, or as pAttPkan Donor Plasmid

Figure 50 is a depiction of the physical map (Figure 50A), and the nucleotide sequence (Figure 50B-C), for the Donor plasmid pDONR202 which donates a kanamycin-resistant vector in the BP Reaction.

25 **Figure 51** is a depiction of the physical map (Figure 51A), and the nucleotide sequence (Figure 51B-C), for the Donor plasmid pDONR203 which donates a kanamycin-resistant vector in the BP Reaction.

Figure 52 is a depiction of the physical map (Figure 52A), and the nucleotide sequence (Figure 52B-C), for the Donor plasmid pDONR204 which donates a kanamycin-resistant vector in the BP Reaction.

Figure 53 is a depiction of the physical map (Figure 53A), and the nucleotide sequence (Figure 53B-C), for the Donor plasmid pDONR205 which donates a tetracycline-resistant vector in the BP Reaction.

Figure 54 is a depiction of the physical map (Figure 54A), and the nucleotide sequence (Figure 54B-C), for the Donor plasmid pDONR206 which donates a gentamycin-resistant vector in the BP Reaction. This vector may also be referred to as pENTR22 attP Donor Plasmid, pAttPGenr Donor Plasmid, or pAttPgent Donor Plasmid.

Figure 55 depicts the attB1 site, and the physical map, of an Entry Clone (pENTR7) of CAT subcloned into the Destination Vector pDEST2 (Figure 22).

Figure 56 depicts the DNA components of Reaction B of the one-tube BxP reaction described in Example 16, pEZC7102 and attB-tet-PCR.

Figure 57 is a physical map of the desired product of Reaction B of the one-tube BxP reaction described in Example 16, tetx7102.

Figure 58 is a physical map of the Destination Vector pEZC8402.

Figure 59 is a physical map of the expected tet^r subclone product, tetx8402, resulting from the LxR Reaction with tetx7102 (Figure 57) plus pEZC8402 (Figure 58).

Figure 60 is a schematic depiction of the bacteriophage lambda recombination pathways in *E. coli*.

Figure 61 is a schematic depiction of the DNA molecules participating in the LR Reaction. Two different co-integrates form during the LR Reaction (only one of which is shown here), depending on whether attL1 and attR1 or attL2 and attR2 are first to recombine. In one aspect, the invention provides directional cloning of a nucleic acid molecule of interest, since the recombination sites react with specificity (attL1 reacts with attR1; attL2 with attR2; attB1 with attP1; and attB2 with attP2). Thus, positioning of the sites allows construction of desired vectors having recombined fragments in the desired orientation.

Figure 62 is a depiction of native and fusion protein expression using the recombinational cloning methods and compositions of the invention. In the upper figure depicting native protein expression, all of the translational start signals are

included between the attB1 and attB2 sites; therefore, these signals must be present in the starting Entry Clone. The lower figure depicts fusion protein expression (here showing expression with both N-terminal and C-terminal fusion tags so that ribosomes read through attB1 and attB2 to create the fusion protein). Unlike native protein expression vectors, N-terminal fusion vectors have their translational start signals upstream of the attB1 site.

Figure 63 is a schematic depiction of three GATEWAY™ Cloning System cassettes. Three blunt-ended cassettes are depicted which convert standard expression vectors to Destination Vectors. Each of the depicted cassettes provides amino-terminal fusions in one of three possible reading frames, and each has a distinctive restriction cleavage site as shown.

Figure 64 shows the physical maps of plasmids containing three attR reading frame cassettes, pEZX15101 (reading frame A; Figure 64A), pEZX15102 (reading frame B; Figure 64B), and pEZX15103 (reading frame C; Figure 64C).

Figure 65 depicts the attB primers used for amplifying the tet^r and amp^r genes from pBR322 by the cloning methods of the invention.

Figure 66 is a table listing the results of recombinational cloning of the tet^r and amp^r PCR products made using the primers shown in Figure 65.

Figure 67 is a graph showing the effect of the number of guanines (G's) contained on the 5' end of the PCR primers on the cloning efficiency of PCR products. It is noted, however, that other nucleotides besides guanine (including A, T, C, U or combinations thereof) may be used as 5' extensions on the PCR primers to enhance cloning efficiency of PCR products.

Figure 68 is a graph showing a titration of various amounts of attP and attB reactants in the BxP reaction, and the effects on cloning efficiency of PCR products.

Figure 69 is a series of graphs showing the effects of various weights (Figure 69A) or moles (Figure 69B) of a 256 bp PCR product on formation of colonies, and on efficiency of cloning of the 256 bp PCR product into a Donor Vector (Figure 69C).

Figure 70 is a series of graphs showing the effects of various weights (Figure 70A) or moles (Figure 70B) of a 1 kb PCR product on formation of colonies, and on efficiency of cloning of the 1 kb PCR product into a Donor Vector (Figure 70C).

Figure 71 is a series of graphs showing the effects of various weights (Figure 71A) or moles (Figure 71B) of a 1.4 kb PCR product on formation of colonies, and on efficiency of cloning of the 1.4 kb PCR product into a Donor Vector (Figure 71C).

Figure 72 is a series of graphs showing the effects of various weights (Figure 72A) or moles (Figure 72B) of a 3.4 kb PCR product on formation of colonies, and on efficiency of cloning of the 3.4 kb PCR product into a Donor Vector (Figure 72C).

Figure 73 is a series of graphs showing the effects of various weights (Figure 73A) or moles (Figure 73B) of a 4.6 kb PCR product on formation of colonies, and on efficiency of cloning of the 4.6 kb PCR product into a Donor Vector (Figure 73C).

Figure 74 is photograph of an ethidium bromide-stained gel of a titration of a 6.9 kb PCR product in a BxP reaction.

Figure 75 is a graph showing the effects of various amounts of a 10.1 kb PCR product on formation of colonies upon cloning of the 10.1 kb PCR product into a Donor Vector.

Figure 76 is photograph of an ethidium bromide-stained gel of a titration of a 10.1 kb PCR product in a BxP reaction.

Figure 77 is a table summarizing the results of the PCR product cloning efficiency experiments depicted in Figures 69-74, for PCR fragments ranging in size from 0.256 kb to 6.9 kb.

Figure 78 is a depiction of the sequences at the ends of attR Cassettes. Sequences contributed by the Cm^r -ccdB cassette are shown, including the outer ends of the flanking attR sites (boxed). The staggered cleavage sites for Int are indicated in the boxed regions. Following recombination with an Entry Clone, only the outer sequences in attR sites contribute to the resulting attB sites in the

Expression Clone. The underlined sequences at both ends dictate the different reading frames (reading frames A, B, or C, with two alternative reading frame C cassettes depicted) for fusion proteins.

5 **Figure 79** is a depiction of several different attR cassettes (in reading frames A, B, or C) which may provide fusion codons at the amino-terminus of the encoded protein.

Figure 80 illustrates the single-cutting restriction sites in an attR reading frame A cassette of the invention.

10 **Figure 81** illustrates the single-cutting restriction sites in an attR reading frame B cassette of the invention.

Figure 82 illustrates the single-cutting restriction sites in two alternative attR reading frame C cassettes of the invention (Figures 82A and 82B) depicted in Figure 78.

15 **Figure 83** shows the physical map (Figure 83A), and the nucleotide sequence (Figure 83B-C), for an attR reading frame C parent plasmid prfC Parent III, which contains an attR reading frame C cassette of the invention (alternative A in Figures 78 and 82).

Figure 84 is a physical map of plasmid pEZC1301.

Figure 85 is a physical map of plasmid pEZC1313.

20 **Figure 86** is a physical map of plasmid pEZ14032.

Figure 87 is a physical map of plasmid pMAB58.

Figure 88 is a physical map of plasmid pMAB62.

Figure 89 is a depiction of a synthesis reaction using two pairs of homologous primers of the invention.

25 **Figure 90** is a schematic depiction of the physical map (Figure 90A), and the nucleotide sequence (Figure 90B-D), of Destination Vector pDEST28.

Figure 91 is a schematic depiction of the physical map (Figure 91A), and the nucleotide sequence (Figure 91B-D), of Destination Vector pDEST29.

30 **Figure 92** is a schematic depiction of the physical map (Figure 92A), and the nucleotide sequence (Figure 92B-D), of Destination Vector pDEST30.

Figure 93 is a schematic depiction of the physical map (Figure 93A), and the nucleotide sequence (Figure 93B-D), of Destination Vector pDEST31.

Figure 94 is a schematic depiction of the physical map (Figure 94A), and the nucleotide sequence (Figure 94B-E), of Destination Vector pDEST32.

Figure 95 is a schematic depiction of the physical map (Figure 95A), and the nucleotide sequence (Figure 95B-D), of Destination Vector pDEST33.

Figure 96 is a schematic depiction of the physical map (Figure 96A), and the nucleotide sequence (Figure 96B-D), of Destination Vector pDEST34.

Figure 97 is a depiction of the physical map (Figure 97A), and the nucleotide sequence (Figure 97B-C), for the Donor plasmid pDONR207 which donates a gentamycin-resistant vector in the BP Reaction.

Figure 98 is a schematic depiction of the physical map (Figure 98A), and the nucleotide sequence (Figure 98B-D), of the 2-hybrid vector pMAB85.

Figure 99 is a schematic depiction of the physical map (Figure 99A), and the nucleotide sequence (Figure 99B-D), of the 2-hybrid vector pMAB86.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

In the description that follows, a number of terms used in recombinant DNA technology are utilized extensively. In order to provide a clear and consistent understanding of the specification and claims, including the scope to be given such terms, the following definitions are provided.

Byproduct: is a daughter molecule (a new clone produced after the second recombination event during the recombinational cloning process) lacking the segment which is desired to be cloned or subcloned.

Cointegrate: is at least one recombination intermediate nucleic acid molecule of the present invention that contains both parental (starting) molecules. It will usually be linear. In some embodiments it can be circular. RNA and polypeptides may be expressed from cointegrates using an appropriate host cell strain, for example *E. coli* DB3.1 (particularly *E. coli* LIBRARY EFFICIENCY®).

DB3.1™ Competent Cells), and selecting for both selection markers found on the cointegrate molecule.

Host: is any prokaryotic or eukaryotic organism that can be a recipient of the recombinational cloning Product, vector, or nucleic acid molecule of the invention. A "host," as the term is used herein, includes prokaryotic or eukaryotic organisms that can be genetically engineered. For examples of such hosts, see Maniatis *et al.*, *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor Laboratory, Cold Spring Harbor, New York (1982).

Insert or Inserts: include the desired nucleic acid segment or a population of nucleic acid segments (segment *A* of Figure 1) which may be manipulated by the methods of the present invention. Thus, the terms Insert(s) are meant to include a particular nucleic acid (preferably DNA) segment or a population of segments. Such Insert(s) can comprise one or more nucleic acid molecules.

Insert Donor: is one of the two parental nucleic acid molecules (e.g. RNA or DNA) of the present invention which carries the Insert. The Insert Donor molecule comprises the Insert flanked on both sides with recombination sites. The Insert Donor can be linear or circular. In one embodiment of the invention, the Insert Donor is a circular DNA molecule and further comprises a cloning vector sequence outside of the recombination signals (see Figure 1). When a population of Inserts or population of nucleic acid segments are used to make the Insert Donor, a population of Insert Donors results and may be used in accordance with the invention. Examples of such Insert Donor molecules are GATEWAY™ Entry Vectors, which include but are not limited to those Entry Vectors depicted in Figures 10-20, as well as other vectors comprising a gene of interest flanked by one or more *attL* sites (e.g., *attL1*, *attL2*, etc.), or by one or more *attB* sites (e.g., *attB1*, *attB2*, etc.) for the production of library clones.

Product: is one of the desired daughter molecules comprising the *A* and *D* sequences which is produced after the second recombination event during the recombinational cloning process (see Figure 1). The Product contains the nucleic acid which was to be cloned or subcloned. In accordance with the invention, when a population of Insert Donors are used, the resulting population of Product

molecules will contain all or a portion of the population of Inserts of the Insert Donors and preferably will contain a representative population of the original molecules of the Insert Donors.

Promoter: is a DNA sequence generally described as the 5'-region of a gene, located proximal to the start codon. The transcription of an adjacent DNA segment is initiated at the promoter region. A repressible promoter's rate of transcription decreases in response to a repressing agent. An inducible promoter's rate of transcription increases in response to an inducing agent. A constitutive promoter's rate of transcription is not specifically regulated, though it can vary under the influence of general metabolic conditions.

Recognition sequence: Recognition sequences are particular sequences which a protein, chemical compound, DNA, or RNA molecule (*e.g.*, restriction endonuclease, a modification methylase, or a recombinase) recognizes and binds. In the present invention, a recognition sequence will usually refer to a recombination site. For example, the recognition sequence for Cre recombinase is *loxP* which is a 34 base pair sequence comprised of two 13 base pair inverted repeats (serving as the recombinase binding sites) flanking an 8 base pair core sequence. See Figure 1 of Sauer, B., *Current Opinion in Biotechnology* 5:521-527 (1994). Other examples of recognition sequences are the *attB*, *attP*, *attL*, and *attR* sequences which are recognized by the recombinase enzyme λ Integrase. *attB* is an approximately 25 base pair sequence containing two 9 base pair core-type Int binding sites and a 7 base pair overlap region. *attP* is an approximately 240 base pair sequence containing core-type Int binding sites and arm-type Int binding sites as well as sites for auxiliary proteins integration host factor (IHF), FIS and excisionase (Xis). See Landy, *Current Opinion in Biotechnology* 3:699-707 (1993). Such sites may also be engineered according to the present invention to enhance production of products in the methods of the invention. When such engineered sites lack the P1 or H1 domains to make the recombination reactions irreversible (*e.g.*, *attR* or *attP*), such sites may be designated *attR'* or *attP'* to show that the domains of these sites have been modified in some way.

Recombination proteins: include excisive or integrative proteins, enzymes, co-factors or associated proteins that are involved in recombination reactions involving one or more recombination sites, which may be wild-type proteins (See Landy, *Current Opinion in Biotechnology* 3:699-707 (1993)), or mutants, derivatives (e.g., fusion proteins containing the recombination protein sequences or fragments thereof), fragments, and variants thereof.

Recombination site: is a recognition sequence on a DNA molecule participating in an integration/recombination reaction by the recombinational cloning methods of the invention. Recombination sites are discrete sections or segments of DNA on the participating nucleic acid molecules that are recognized and bound by a site-specific recombination protein during the initial stages of integration or recombination. For example, the recombination site for Cre recombinase is *loxP* which is a 34 base pair sequence comprised of two 13 base pair inverted repeats (serving as the recombinase binding sites) flanking an 8 base pair core sequence. See Figure 1 of Sauer, B., *Curr. Opin. Biotech.* 5:521-527 (1994). Other examples of recognition sequences include the *attB*, *attP*, *attL*, and *attR* sequences described herein, and mutants, fragments, variants and derivatives thereof, which are recognized by the recombination protein λ Int and by the auxiliary proteins integration host factor (IHF), FIS and excisionase (Xis). See Landy, *Curr. Opin. Biotech.* 3:699-707 (1993).

Recombinational Cloning: is a method described herein, whereby segments of nucleic acid molecules or populations of such molecules are exchanged, inserted, replaced, substituted or modified, *in vitro* or *in vivo*. By "*in vitro*" and "*in vivo*" herein is meant recombinational cloning that is carried out outside of host cells (e.g., in cell-free systems) or inside of host cells (e.g., using recombination proteins expressed by host cells), respectively.

Repression cassette: is a nucleic acid segment that contains a repressor or a Selectable marker present in the subcloning vector.

Selectable marker: is a DNA segment that allows one to select for or against a molecule (e.g., a replicon) or a cell that contains it, often under particular conditions. These markers can encode an activity, such as, but not limited to,

production of RNA, peptide, or protein, or can provide a binding site for RNA, peptides, proteins, inorganic and organic compounds or compositions and the like. Examples of Selectable markers include but are not limited to: (1) DNA segments that encode products which provide resistance against otherwise toxic compounds (e.g., antibiotics); (2) DNA segments that encode products which are otherwise lacking in the recipient cell (e.g., tRNA genes, auxotrophic markers); (3) DNA segments that encode products which suppress the activity of a gene product; (4) DNA segments that encode products which can be readily identified (e.g., phenotypic markers such as β -galactosidase, green fluorescent protein (GFP), and cell surface proteins); (5) DNA segments that bind products which are otherwise detrimental to cell survival and/or function; (6) DNA segments that otherwise inhibit the activity of any of the DNA segments described in Nos. 1-5 above (e.g., antisense oligonucleotides); (7) DNA segments that bind products that modify a substrate (e.g. restriction endonucleases); (8) DNA segments that can be used to isolate or identify a desired molecule (e.g. specific protein binding sites); (9) DNA segments that encode a specific nucleotide sequence which can be otherwise non-functional (e.g., for PCR amplification of subpopulations of molecules); (10) DNA segments, which when absent, directly or indirectly confer resistance or sensitivity to particular compounds; (11) DNA segments that encode products which are toxic in recipient cells; (12) DNA segments that inhibit replication, partition or heritability of nucleic acid molecules that contain them; and/or (13) DNA segments that encode conditional replication functions, e.g., replication in certain hosts or host cell strains or under certain environmental conditions (e.g., temperature, nutritional conditions, etc.).

Selection scheme: is any method which allows selection, enrichment, or identification of a desired Product or Product(s) from a mixture containing an Entry Clone or Vector, a Destination Vector, a Donor Vector, an Expression Clone or Vector, any intermediates (e.g. a Cointegrate or a replicon), and/or Byproducts. The selection schemes of one preferred embodiment have at least two components that are either linked or unlinked during recombinational cloning. One component is a Selectable marker. The other component controls the expression *in vitro* or *in vivo* of the Selectable marker, or survival of the cell (or

the nucleic acid molecule, *e.g.*, a replicon) harboring the plasmid carrying the Selectable marker. Generally, this controlling element will be a repressor or inducer of the Selectable marker, but other means for controlling expression or activity of the Selectable marker can be used. Whether a repressor or activator is used will depend on whether the marker is for a positive or negative selection, and the exact arrangement of the various DNA segments, as will be readily apparent to those skilled in the art. A preferred requirement is that the selection scheme results in selection of or enrichment for only one or more desired Products. As defined herein, selecting for a DNA molecule includes (a) selecting or enriching for the presence of the desired DNA molecule, and (b) selecting or enriching against the presence of DNA molecules that are not the desired DNA molecule.

In one embodiment, the selection schemes (which can be carried out in reverse) will take one of three forms, which will be discussed in terms of Figure 1. The first, exemplified herein with a Selectable marker and a repressor therefore, selects for molecules having segment *D* and lacking segment *C*. The second selects against molecules having segment *C* and for molecules having segment *D*. Possible embodiments of the second form would have a DNA segment carrying a gene toxic to cells into which the *in vitro* reaction products are to be introduced. A toxic gene can be a DNA that is expressed as a toxic gene product (a toxic protein or RNA), or can be toxic in and of itself. (In the latter case, the toxic gene is understood to carry its classical definition of "heritable trait".)

Examples of such toxic gene products are well known in the art, and include, but are not limited to, restriction endonucleases (*e.g.*, *DpnI*), apoptosis-related genes (*e.g.* ASK1 or members of the *bcl-2/ced-9* family), retroviral genes including those of the human immunodeficiency virus (HIV), defensins such as NP-1, inverted repeats or paired palindromic DNA sequences, bacteriophage lytic genes such as those from Φ X174 or bacteriophage T4; antibiotic sensitivity genes such as *rpsL*, antimicrobial sensitivity genes such as *pheS*, plasmid killer genes, eukaryotic transcriptional vector genes that produce a gene product toxic to bacteria, such as GATA-1, and genes that kill hosts in the absence of a suppressing function, *e.g.*, *kicB*, *ccdB*, Φ X174 *E* (Liu, Q. *et al.*, *Curr. Biol.*

8:1300-1309 (1998)), and other genes that negatively affect replicon stability and/or replication. A toxic gene can alternatively be selectable *in vitro*, e.g., a restriction site.

Many genes coding for restriction endonucleases operably linked to inducible promoters are known, and may be used in the present invention. See, e.g. U.S. Patent Nos. 4,960,707 (*DpnI* and *DpnII*); 5,000,333, 5,082,784 and 5,192,675 (*KpnI*); 5,147,800 (*NgoAIII* and *NgoAI*); 5,179,015 (*FspI* and *HaeIII*); 5,200,333 (*HaeII* and *TaqI*); 5,248,605 (*HpaII*); 5,312,746 (*ClaI*); 5,231,021 and 5,304,480 (*XhoI* and *XhoII*); 5,334,526 (*AluI*); 5,470,740 (*NsiI*); 5,534,428 (*SstI/SacI*); 5,202,248 (*NcoI*); 5,139,942 (*NdeI*); and 5,098,839 (*PacI*). See also Wilson, G.G., *Nucl. Acids Res.* 19:2539-2566 (1991); and Lunnen, K.D., *et al.*, *Gene* 74:25-32 (1988).

In the second form, segment *D* carries a Selectable marker. The toxic gene would eliminate transformants harboring the Vector Donor, Cointegrate, and Byproduct molecules, while the Selectable marker can be used to select for cells containing the Product and against cells harboring only the Insert Donor.

The third form selects for cells that have both segments *A* and *D* in *cis* on the same molecule, but not for cells that have both segments in *trans* on different molecules. This could be embodied by a Selectable marker that is split into two inactive fragments, one each on segments *A* and *D*.

The fragments are so arranged relative to the recombination sites that when the segments are brought together by the recombination event, they reconstitute a functional Selectable marker. For example, the recombinational event can link a promoter with a structural nucleic acid molecule (e.g., a gene), can link two fragments of a structural nucleic acid molecule, or can link nucleic acid molecules that encode a heterodimeric gene product needed for survival, or can link portions of a replicon.

Site-specific recombinase: is a type of recombinase which typically has at least the following four activities (or combinations thereof): (1) recognition of one or two specific nucleic acid sequences; (2) cleavage of said sequence or sequences; (3) topoisomerase activity involved in strand exchange; and (4) ligase

activity to reseal the cleaved strands of nucleic acid. See Sauer, B., *Current Opinions in Biotechnology* 5:521-527 (1994). Conservative site-specific recombination is distinguished from homologous recombination and transposition by a high degree of sequence specificity for both partners. The strand exchange mechanism involves the cleavage and rejoining of specific DNA sequences in the absence of DNA synthesis (Landy, A. (1989) *Ann. Rev. Biochem.* 58:913-949).

Subcloning vector: is a cloning vector comprising a circular or linear nucleic acid molecule which includes preferably an appropriate replicon. In the present invention, the subcloning vector (segment *D* in Figure 1) can also contain functional and/or regulatory elements that are desired to be incorporated into the final product to act upon or with the cloned DNA Insert (segment *A* in Figure 1). The subcloning vector can also contain a Selectable marker (preferably DNA).

Vector: is a nucleic acid molecule (preferably DNA) that provides a useful biological or biochemical property to an Insert. Examples include plasmids, phages, autonomously replicating sequences (ARS), centromeres, and other sequences which are able to replicate or be replicated *in vitro* or in a host cell, or to convey a desired nucleic acid segment to a desired location within a host cell. A Vector can have one or more restriction endonuclease recognition sites at which the sequences can be cut in a determinable fashion without loss of an essential biological function of the vector, and into which a nucleic acid fragment can be spliced in order to bring about its replication and cloning. Vectors can further provide primer sites, *e.g.*, for PCR, transcriptional and/or translational initiation and/or regulation sites, recombinational signals, replicons, Selectable markers, *etc.* Clearly, methods of inserting a desired nucleic acid fragment which do not require the use of homologous recombination, transpositions or restriction enzymes (such as, but not limited to, UDG cloning of PCR fragments (U.S. Patent No. 5,334,575, entirely incorporated herein by reference), T:A cloning, and the like) can also be applied to clone a fragment into a cloning vector to be used according to the present invention. The cloning vector can further contain one or more selectable markers suitable for use in the identification of cells transformed with the cloning vector.

Vector Donor: is one of the two parental nucleic acid molecules (e.g. RNA or DNA) of the present invention which carries the DNA segments comprising the DNA vector which is to become part of the desired Product. The Vector Donor comprises a subcloning vector *D* (or it can be called the cloning vector if the Insert Donor does not already contain a cloning vector (e.g., for PCR fragments containing *attB* sites; see below)) and a segment *C* flanked by recombination sites (see Figure 1). Segments *C* and/or *D* can contain elements that contribute to selection for the desired Product daughter molecule, as described above for selection schemes. The recombination signals can be the same or different, and can be acted upon by the same or different recombinases. In addition, the Vector Donor can be linear or circular. Examples of such Vector Donor molecules include GATEWAY™ Destination Vectors, which include but are not limited to those Destination Vectors depicted in Figures 21-47 and 90-96.

Primer: refers to a single stranded or double stranded oligonucleotide that is extended by covalent bonding of nucleotide monomers during amplification or polymerization of a nucleic acid molecule (e.g. a DNA molecule). In a preferred aspect, a primer comprises one or more recombination sites or portions of such recombination sites. Portions of recombination sites comprise at least 2 bases (or basepairs, abbreviated herein as "bp"), at least 5-200 bases, at least 10-100 bases, at least 15-75 bases, at least 15-50 bases, at least 15-25 bases, or at least 16-25 bases, of the recombination sites of interest, as described in further detail below and in the Examples. When using portions of recombination sites, the missing portion of the recombination site may be provided as a template by the newly synthesized nucleic acid molecule. Such recombination sites may be located within and/or at one or both termini of the primer. Preferably, additional sequences are added to the primer adjacent to the recombination site(s) to enhance or improve recombination and/or to stabilize the recombination site during recombination. Such stabilization sequences may be any sequences (preferably G/C rich sequences) of any length. Preferably, such sequences range in size from 1 to about 1000 bases, 1 to about 500 bases, and 1 to about 100 bases, 1 to about 60 bases, 1 to about 25, 1 to about 10, 2 to about 10 and preferably about 4 bases.

Preferably, such sequences are greater than 1 base in length and preferably greater than 2 bases in length.

Template: refers to double stranded or single stranded nucleic acid molecules which are to be amplified, synthesized or sequenced. In the case of double stranded molecules, denaturation of its strands to form a first and a second strand is preferably performed before these molecules will be amplified, synthesized or sequenced, or the double stranded molecule may be used directly as a template. For single stranded templates, a primer complementary to a portion of the template is hybridized under appropriate conditions and one or more polypeptides having polymerase activity (e.g. DNA polymerases and/or reverse transcriptases) may then synthesize a nucleic acid molecule complementary to all or a portion of said template. Alternatively, for double stranded templates, one or more promoters may be used in combination with one or more polymerases to make nucleic acid molecules complementary to all or a portion of the template. The newly synthesized molecules, according to the invention, may be equal or shorter in length than the original template. Additionally, a population of nucleic acid templates may be used during synthesis or amplification to produce a population of nucleic acid molecules typically representative of the original template population.

Adapter: is an oligonucleotide or nucleic acid fragment or segment (preferably DNA) which comprises one or more recombination sites (or portions of such recombination sites) which in accordance with the invention can be added to a circular or linear Insert Donor molecule as well as other nucleic acid molecules described herein. When using portions of recombination sites, the missing portion may be provided by the Insert Donor molecule. Such adapters may be added at any location within a circular or linear molecule, although the adapters are preferably added at or near one or both termini of a linear molecule. Preferably, adapters are positioned to be located on both sides (flanking) a particular nucleic acid molecule of interest. In accordance with the invention, adapters may be added to nucleic acid molecules of interest by standard recombinant techniques (e.g. restriction digest and ligation). For example, adapters may be added to a circular molecule by first digesting the molecule with

an appropriate restriction enzyme, adding the adapter at the cleavage site and reforming the circular molecule which contains the adapter(s) at the site of cleavage. In other aspects, adapters may be added by homologous recombination, by integration of RNA molecules, and the like. Alternatively, adapters may be ligated directly to one or more and preferably both termini of a linear molecule thereby resulting in linear molecule(s) having adapters at one or both termini. In one aspect of the invention, adapters may be added to a population of linear molecules, (e.g. a cDNA library or genomic DNA which has been cleaved or digested) to form a population of linear molecules containing adapters at one and preferably both termini of all or substantial portion of said population.

Adapter-Primer: is primer molecule which comprises one or more recombination sites (or portions of such recombination sites) which in accordance with the invention can be added to a circular or linear nucleic acid molecule described herein. When using portions of recombination sites, the missing portion may be provided by a nucleic acid molecule (e.g., an adapter) of the invention. Such adapter-primers may be added at any location within a circular or linear molecule, although the adapter-primers are preferably added at or near one or both termini of a linear molecule. Examples of such adapter-primers and the use thereof in accordance with the methods of the invention are shown in Example 25 herein. Such adapter-primers may be used to add one or more recombination sites or portions thereof to circular or linear nucleic acid molecules in a variety of contexts and by a variety of techniques, including but not limited to amplification (e.g., PCR), ligation (e.g., enzymatic or chemical/synthetic ligation), recombination (e.g., homologous or non-homologous (illegitimate) recombination) and the like.

Library: refers to a collection of nucleic acid molecules (circular or linear). In one embodiment, a library may comprise a plurality (*i.e.*, two or more) of DNA molecules, which may or may not be from a common source organism, organ, tissue, or cell. In another embodiment, a library is representative of all or a portion or a significant portion of the DNA content of an organism (a "genomic" library), or a set of nucleic acid molecules representative of all or a portion or a significant portion of the expressed nucleic acid molecules (a cDNA library) in a

cell, tissue, organ or organism. A library may also comprise random sequences made by *de novo* synthesis, mutagenesis of one or more sequences and the like. Such libraries may or may not be contained in one or more vectors.

Amplification: refers to any *in vitro* method for increasing a number of copies of a nucleotide sequence with the use of a polymerase. Nucleic acid amplification results in the incorporation of nucleotides into a DNA and/or RNA molecule or primer thereby forming a new molecule complementary to a template. The formed nucleic acid molecule and its template can be used as templates to synthesize additional nucleic acid molecules. As used herein, one amplification reaction may consist of many rounds of replication. DNA amplification reactions include, for example, polymerase chain reaction (PCR). One PCR reaction may consist of 5-100 "cycles" of denaturation and synthesis of a DNA molecule.

Oligonucleotide: refers to a synthetic or natural molecule comprising a covalently linked sequence of nucleotides which are joined by a phosphodiester bond between the 3' position of the deoxyribose or ribose of one nucleotide and the 5' position of the deoxyribose or ribose of the adjacent nucleotide. This term may be used interchangeably herein with the terms "nucleic acid molecule" and "polynucleotide," without any of these terms necessarily indicating any particular length of the nucleic acid molecule to which the term specifically refers.

Nucleotide: refers to a base-sugar-phosphate combination. Nucleotides are monomeric units of a nucleic acid molecule (DNA and RNA). The term nucleotide includes ribonucleoside triphosphates ATP, UTP, CTG, GTP and deoxyribonucleoside triphosphates such as dATP, dCTP, dITP, dUTP, dGTP, dTTP, or derivatives thereof. Such derivatives include, for example, [α S]dATP, 7-deaza-dGTP and 7-deaza-dATP. The term nucleotide as used herein also refers to dideoxyribonucleoside triphosphates (ddNTPs) and their derivatives. Illustrated examples of dideoxyribonucleoside triphosphates include, but are not limited to, ddATP, ddCTP, ddGTP, ddITP, and ddTTP. According to the present invention, a "nucleotide" may be unlabeled or detectably labeled by well known techniques. Detectable labels include, for example, radioactive isotopes, fluorescent labels, chemiluminescent labels, bioluminescent labels and enzyme labels.

Hybridization: The terms "hybridization" and "hybridizing" refers to base pairing of two complementary single-stranded nucleic acid molecules (RNA and/or DNA) to give a double stranded molecule. As used herein, two nucleic acid molecules may be hybridized, although the base pairing is not completely complementary. Accordingly, mismatched bases do not prevent hybridization of two nucleic acid molecules provided that appropriate conditions, well known in the art, are used. In some aspects, hybridization is said to be under "stringent conditions." By "stringent conditions" as used herein is meant overnight incubation at 42°C in a solution comprising: 50% formamide, 5x SSC (150 mM NaCl, 15mM trisodium citrate), 50 mM sodium phosphate (pH 7.6), 5x Denhardt's solution, 10% dextran sulfate, and 20 g/ml denatured, sheared salmon sperm DNA, followed by washing the filters in 0.1x SSC at about 65°C.

Other terms used in the fields of recombinant DNA technology and molecular and cell biology as used herein will be generally understood by one of ordinary skill in the applicable arts.

Overview

Two reactions constitute the recombinational cloning system of the present invention, referred to herein as the "GATEWAY™ Cloning System," as depicted generally in Figure 1. The first of these reactions, the **LR Reaction** (Figure 2), which may also be referred to interchangeably herein as the **Destination Reaction**, is the main pathway of this system. The LR Reaction is a recombination reaction between an Entry vector or clone and a Destination Vector, mediated by a cocktail of recombination proteins such as the GATEWAY™ LR Clonase™ Enzyme Mix described herein. This reaction transfers nucleic acid molecules of interest (which may be genes, cDNAs, cDNA libraries, or fragments thereof) from the Entry Clone to an Expression Vector, to create an Expression Clone.

The sites labeled L, R, B, and P are respectively the attL, attR, attB, and attP recombination sites for the bacteriophage λ recombination proteins that constitute the Clonase cocktail (referred to herein variously as "Clonase" or

“GATEWAY™ LR Clonase™ Enzyme Mix” (for recombination protein mixtures mediating attL x attR recombination reactions, as described herein) or “GATEWAY™ BP Clonase™ Enzyme Mix” (for recombination protein mixtures mediating attB x attP recombination reactions, as described herein)). The Recombinational Cloning reactions are equivalent to concerted, highly specific, cutting and ligation reactions. Viewed in this way, the recombination proteins cut to the left and right of the nucleic acid molecule of interest in the Entry Clone and ligate it into the Destination vector, creating a new Expression Clone.

The nucleic acid molecule of interest in an Expression Clone is flanked by the small attB1 and attB2 sites. The orientation and reading frame of the nucleic acid molecule of interest are maintained throughout the subcloning, because attL1 reacts only with attR1, and attL2 reacts only with attR2. Likewise, attB1 reacts only with attP1, and attB2 reacts only with attP2. Thus, the invention also relates to methods of controlled or directional cloning using the recombination sites of the invention (or portions thereof), including variants, fragments, mutants and derivatives thereof which may have altered or enhanced specificity. The invention also relates more generally to any number of recombination site partners or pairs (where each recombination site is specific for and interacts with its corresponding recombination site). Such recombination sites are preferably made by mutating or modifying the recombination site to provide any number of necessary specificities (e.g., attB1-10, attP1-10, attL1-10, attR1-10, etc.), non-limiting examples of which are described in detail in the Examples herein.

When an aliquot from the recombination reaction is transformed into host cells (e.g., *E. coli*) and spread on plates containing an appropriate selection agent, e.g., an antibiotic such as ampicillin with or without methicillin, cells that take up the desired clone form colonies. The unreacted Destination Vector does not give ampicillin-resistant colonies, even though it carries the ampicillin-resistance gene, because it contains a toxic gene, e.g., *ccdB*. Thus selection for ampicillin resistance selects for *E. coli* cells that carry the desired product, which usually comprise >90% of the colonies on the ampicillin plate.

To participate in the Recombinational (or “GATEWAY™”) Cloning Reaction, a nucleic acid molecule of interest first may be cloned into an Entry

Vector, creating an Entry Clone. Multiple options are available for creating Entry Clones, including: cloning of PCR sequences with terminal attB recombination sites into Entry Vectors; using the GATEWAY™ Cloning System recombination reaction; transfer of genes from libraries prepared in GATEWAY™ Cloning System vectors by recombination into Entry Vectors; and cloning of restriction enzyme-generated fragments and PCR fragments into Entry Vectors by standard recombinant DNA methods. These approaches are discussed in further detail herein.

A key advantage of the GATEWAY™ Cloning System is that a nucleic acid molecule of interest (or even a population of nucleic acid molecules of interest) present as an Entry Clone can be subcloned in parallel into one or more Destination Vectors in a simple reactions for anywhere from about 30 seconds to about 60 minutes (preferably about 1-60 minutes, about 1-45 minutes, about 1-30 minutes, about 2-60 minutes, about 2-45 minutes, about 2-30 minutes, about 1-2 minutes, about 30-60 minutes, about 45-60 minutes, or about 30-45 minutes). Longer reaction times (*e.g.*, 2-24 hours, or overnight) may increase recombination efficiency, particularly where larger nucleic acid molecules are used, as described in the Examples herein. Moreover, a high percentage of the colonies obtained carry the desired Expression Clone. This process is illustrated schematically in Figure 3, which shows an advantage of the invention in which the molecule of interest can be moved simultaneously or separately into multiple Destination Vectors. In the LR Reaction, one or both of the nucleic acid molecules to be recombined may have any topology (*e.g.*, linear, relaxed circular, nicked circular, supercoiled, etc.), although one or both are preferably linear.

The second major pathway of the GATEWAY™ Cloning System is the **BP Reaction** (Figure 4), which may also be referred to interchangeably herein as the **Entry Reaction** or the **Gateward Reaction**. The BP Reaction may recombine an Expression Clone with a Donor Plasmid (the counterpart of the byproduct in Figure 2). This reaction transfers the nucleic acid molecule of interest (which may have any of a variety of topologies, including linear, coiled, supercoiled, etc.) in the Expression Clone into an Entry Vector, to produce a new Entry Clone. Once this nucleic acid molecule of interest is cloned into an Entry

Vector, it can be transferred into new Expression Vectors, through the LR Reaction as described above. In the BP Reaction, one or both of the nucleic acid molecules to be recombined may have any topology (*e.g.*, linear, relaxed circular, nicked circular, supercoiled, etc.), although one or both are preferably linear.

5 A useful variation of the BP Reaction permits rapid cloning and expression of products of amplification (*e.g.*, PCR) or nucleic acid synthesis. Amplification (*e.g.*, PCR) products synthesized with primers containing terminal 25 bp attB sites serve as efficient substrates for the Gateway Cloning reaction. Such amplification products may be recombined with a Donor Vector to produce an Entry Clone (see
10 Figure 7). The result is an Entry Clone containing the amplification fragment. Such Entry Clones can then be recombined with Destination Vectors -- through the LR Reaction -- to yield Expression Clones of the PCR product.

Additional details of the LR Reaction are shown in Figure 5A. The GATEWAY™ LR Clonase™ Enzyme Mix that mediates this reaction contains
15 lambda recombination proteins Int (Integrase), Xis (Excisionase), and IHF (Integration Host Factor). In contrast, the GATEWAY™ BP Clonase™ Enzyme Mix, which mediates the BP Reaction (Figure 5B), comprises Int and IHF alone.

The recombination (att) sites of each vector comprise two distinct segments, donated by the parental vectors. The staggered lines dividing the two
20 portions of each att site, depicted in Figures 5A and 5B, represent the seven-base staggered cut produced by Int during the recombination reactions. This structure is seen in greater detail in Figure 6, which displays the attB recombination sequences of an Expression Clone, generated by recombination between the attL1 and attL2 sites of an Entry Clone and the attR1 and attR2 sites of a Destination
25 Vector.

The nucleic acid molecule of interest in the Expression Clone is flanked by attB sites: attB1 to the left (amino terminus) and attB2 to the right (carboxy terminus). The bases in attB1 to the left of the seven-base staggered cut produced by Int are derived from the Destination vector, and the bases to the right of the
30 staggered cut are derived from the Entry Vector (see Figure 6). Note that the sequence is displayed in triplets corresponding to an open reading frame. If the reading frame of the nucleic acid molecule of interest cloned in the Entry Vector

is in phase with the reading frame shown for attB1, amino-terminal protein fusions can be made between the nucleic acid molecule of interest and any GATEWAY™ Cloning System Destination Vector encoding an amino-terminal fusion domain. Entry Vectors and Destination Vectors that enable cloning in all three reading frames are described in more detail herein, particularly in the Examples.

The LR Reaction allows the transfer of a desired nucleic acid molecule of interest into new Expression Vectors by recombining a Entry Clone with various Destination Vectors. To participate in the LR or Destination Reaction, however, a nucleic acid molecule of interest preferably is first converted to a Entry Clone. Entry Clones can be made in a number of ways, as shown in Figure 7.

One approach is to clone the nucleic acid molecule of interest into one or more of the Entry Vectors, using standard recombinant DNA methods, with restriction enzymes and ligase. The starting DNA fragment can be generated by restriction enzyme digestion or as a PCR product. The fragment is cloned between the attL1 and attL2 recombination sites in the Entry Vector. Note that a toxic or "death" gene (*e.g.*, *ccdB*), provided to minimize background colonies from incompletely digested Entry Vector, must be excised and replaced by the nucleic acid molecule of interest.

A second approach to making an Entry Clone (Figure 7) is to make a library (genomic or cDNA) in an Entry Vector, as described in detail herein. Such libraries may then be transferred into Destination Vectors for expression screening, for example in appropriate host cells such as yeast cells or mammalian cells.

A third approach to making Entry Clones (Figure 7) is to use Expression Clones obtained from cDNA molecules or libraries prepared in Expression Vectors. Such cDNAs or libraries, flanked by attB sites, can be introduced into a Entry Vector by recombination with a Donor Vector via the BP Reaction. If desired, an entire Expression Clone library can be transferred into the Entry Vector through the BP Reaction. Expression Clone cDNA libraries may also be constructed in a variety of prokaryotic and eukaryotic GATEWAY™-modified vectors (*e.g.*, the pEXP501 Expression Vector (see Figure 48), and 2-hybrid and

attB library vectors), as described in detail herein, particularly in the Examples below.

A fourth, and potentially most versatile, approach to making an Entry Clone (Figure 7) is to introduce a sequence for a nucleic acid molecule of interest into an Entry Vector by amplification (*e.g.*, PCR) fragment cloning. This method is diagramed in Figure 8. The DNA sequence first is amplified (for example, with PCR) as outlined in detail below and in the Examples herein, using primers containing one or more bp, two or more bp, three or more bp, four or more bp, five or more bp, preferably six or more bp, more preferably 6-25 bp (particularly 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24 or 25) bp of the attB nucleotide sequences (such as, but not limited to, those depicted in Figure 9), and optionally one or more, two or more, three or more, four or more, and most preferably four or five or more additional terminal nucleotide bases which preferably are guanines. The PCR product then may be converted to a Entry Clone by performing a BP Reaction, in which the attB-PCR product recombines with a Donor Vector containing one or more attP sites. Details of this approach and protocols for PCR fragment subcloning are provided in Examples 8 and 21-25.

A variety of Entry Clones may be produced by these methods, providing a wide array of cloning options; a number of specific Entry Vectors are also available commercially from Life Technologies, Inc. (Rockville, MD). The Examples herein provide a more in-depth description of selected Entry Vectors and details of their cloning sites. Choosing the optimal Entry Vector for a particular application is discussed in Example 4.

Entry Vectors and Destination Vectors should be constructed so that the amino-terminal region of a nucleic acid molecule of interest (*e.g.*, a gene, cDNA library or insert, or fragment thereof) will be positioned next to the attL1 site. Entry Vectors preferably contain the *rrnB* transcriptional terminator upstream of the attL1 site. This sequence ensures that expression of cloned nucleic acid molecules of interest is reliably "off" in *E. coli*, so that even toxic genes can be successfully cloned. Thus, Entry Clones may be designed to be transcriptionally silent. Note also that Entry Vectors, and hence Entry Clones, may contain the kanamycin antibiotic resistance (*kan^r*) gene to facilitate selection of host cells

containing Entry Clones after transformation. In certain applications, however, Entry Clones may contain other selection markers, including but not limited to a gentamycin resistance (*gen^r*) or tetracycline resistance (*tet^r*) gene, to facilitate selection of host cells containing Entry Clones after transformation.

5 Once a nucleic acid molecule of interest has been cloned into an Entry Vector, it may be moved into a Destination Vector. The upper right portion of Figure 5A shows a schematic of a Destination Vector. The thick arrow represents some function (often transcription or translation) that will act on the nucleic acid molecule of interest in the clone. During the recombination reaction, the region
10 between the attR1 and attR2 sites, including a toxic or "death" gene (*e.g.*, *ccdB*), is replaced by the DNA segment from the Entry Clone. Selection for recombinants that have acquired the ampicillin resistance (*amp^r*) gene (carried on the Destination Vector) and that have also lost the death gene ensures that a high percentage (usually >90%) of the resulting colonies will contain the correct insert.

15 To move a nucleic acid molecule of interest into a Destination Vector, the Destination Vector is mixed with the Entry Clone comprising the desired nucleic acid molecule of interest, a cocktail of recombination proteins (*e.g.*, GATEWAY™ LR Clonase™ Enzyme Mix) is added, the mixture is incubated (preferably at about 25°C for about 60 minutes, or longer under certain
20 circumstances, *e.g.* for transfer of large nucleic acid molecules, as described below) and any standard host cell (including bacterial cells such as *E. coli*; animal cells such as insect cells, mammalian cells, nematode cells and the like; plant cells; and yeast cells) strain is transformed with the reaction mixture. The host cell used will be determined by the desired selection (*e.g.*, *E. coli* DB3.1, available
25 commercially from Life Technologies, Inc., allows survival of clones containing the *ccdB* death gene, and thus can be used to select for cointegrate molecules -- *i.e.*, molecules that are hybrids between the Entry Clone and Destination Vector). The Examples below provide further details and protocols for use of Entry and Destination Vectors in transferring nucleic acid molecules of interest and
30 expressing RNAs or polypeptides encoded by these nucleic acid molecules in a variety of host cells.

The cloning system of the invention therefore offers multiple advantages:

- Once a nucleic acid molecule of interest is cloned into the GATEWAY™ Cloning System, it can be moved into and out of other vectors with complete fidelity of reading frame and orientation. That is, since the reactions proceed whereby attL1 on the Entry Clone recombines with attR1 on the Destination Vector, the directionality of the nucleic acid molecule of interest is maintained or may be controlled upon transfer from the Entry Clone into the Destination Vector. Hence, the GATEWAY™ Cloning System provides a powerful and easy method of directional cloning of nucleic acid molecule of interest.
- One-step cloning or subcloning: Mix the Entry Clone and the Destination Vector with Clonase, incubate, and transform.
- Clone PCR products readily by *in vitro* recombination, by adding attB sites to PCR primers. Then directly transfer these Entry Clones into Destination Vectors. This process may also be carried out in one step (see Examples below).
- Powerful selections give high reliability: >90% (and often >99%) of the colonies contain the desired DNA in its new vector.
- One-step conversion of existing standard vectors into GATEWAY™ Cloning System vectors.
- Ideal for large vectors or those with few cloning sites.
- Recombination sites are short (25 bp), and may be engineered to contain no stop codons or secondary structures.
- Reactions may be automated, for high-throughput applications (*e.g.*, for diagnostic purposes or for therapeutic candidate screening).
- The reactions are economical: 0.3 µg of each DNA; no restriction enzymes, phosphatase, ligase, or gel purification. Reactions work well with miniprep DNA.
- Transfer multiple clones, and even libraries, into one or more Destination Vectors, in a single experiment.
- A variety of Destination Vectors may be produced, for applications including, but not limited to:

- Protein expression in *E. coli*: native proteins; fusion proteins with GST, His6, thioredoxin, etc., for purification, or one or more epitope tags; any promoter useful in expressing proteins in *E. coli* may be used, such as ptrc, λP_L , and T7 promoters.
- Protein expression in eukaryotic cells: CMV promoter, baculovirus (with or without His6 tag), Semliki Forest virus, Tet regulation.
- DNA sequencing (all *lac* primers), RNA probes, phagemids (both strands)
- A variety of Entry Vectors (for recombinational cloning entry by standard recombinant DNA methods) may be produced:
 - Strong transcription stop just upstream, for genes toxic to *E. coli*.
 - Three reading frames.
 - With or without TEV protease cleavage site.
 - Motifs for prokaryotic and / or eukaryotic translation.
 - Compatible with commercial cDNA libraries.
- Expression Clone cDNA (attB) libraries, for expression screening, including 2-hybrid libraries and phage display libraries, may also be constructed.

Recombination Site Sequences

In one aspect, the invention relates to nucleic acid molecules, which may or may not be isolated nucleic acid molecules, comprising one or more nucleotide sequences encoding one or more recombination sites or portions thereof. In particular, this aspect of the invention relates to such nucleic acid molecules comprising one or more nucleotide sequences encoding *attB*, *attP*, *attL*, or *attR*, or portions of these recombination site sequences. The invention also relates to mutants, derivatives, and fragments of such nucleic acid molecules. Unless otherwise indicated, all nucleotide sequences that may have been determined by sequencing a DNA molecule herein were determined using manual or automated DNA sequencing, such as dideoxy sequencing, according to methods that are routine to one of ordinary skill in the art (Sanger, F., and Coulson, A.R., *J. Mol. Biol.* 94:444-448 (1975); Sanger, F., *et al.*, *Proc. Natl. Acad. Sci. USA* 74:5463-5467 (1977)). All amino acid sequences of polypeptides encoded by DNA

molecules determined herein were predicted by conceptual translation of a DNA sequence determined as above. Therefore, as is known in the art for any DNA sequence determined by these approaches, any nucleotide sequence determined herein may contain some errors. Nucleotide sequences determined by such methods are typically at least about 90% identical, more typically at least about 95% to at least about 99.9% identical to the actual nucleotide sequence of the sequenced DNA molecule. As is also known in the art, a single insertion or deletion in a determined nucleotide sequence compared to the actual sequence will cause a frame shift in translation of the nucleotide sequence such that the predicted amino acid sequence encoded by a determined nucleotide sequence will be completely different from the amino acid sequence actually encoded by the sequenced DNA molecule, beginning at the point of such an insertion or deletion.

Unless otherwise indicated, each "nucleotide sequence" set forth herein is presented as a sequence of deoxyribonucleotides (abbreviated A, G, C and T). However, by "nucleotide sequence" of a nucleic acid molecule or polynucleotide is intended, for a DNA molecule or polynucleotide, a sequence of deoxyribonucleotides, and for an RNA molecule or polynucleotide, the corresponding sequence of ribonucleotides (A, G, C and U), where each thymidine deoxyribonucleotide (T) in the specified deoxyribonucleotide sequence is replaced by the ribonucleotide uridine (U). Thus, the invention relates to sequences of the invention in the form of DNA or RNA molecules, or hybrid DNA/RNA molecules, and their corresponding complementary DNA, RNA, or DNA/RNA strands.

In a first such aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding *attB1*, or mutants, fragments, variants or derivatives thereof. Such nucleic acid molecules may comprise an *attB1* nucleotide sequence having the sequence set forth in Figure 9, such as: ACAAGTTTGTACAAAAAGCAGGCT, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for *attB1*, or mutants, fragments, variants or derivatives thereof. As one of ordinary skill will appreciate, however, certain mutations, insertions, or deletions of one or more bases in the *attB1* sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional

integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the *attB1* sequence are encompassed within the scope of the invention.

In a related aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding *attB2*, or mutants, fragments, variants or derivatives thereof. Such nucleic acid molecules may comprise an *attB2* nucleotide sequence having the sequence set forth in Figure 9, such as: ACCCAGCTTTCTTGTACAAAGTGGT, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for *attB2*, or mutants, fragments, variants or derivatives thereof. As noted above for *attB1*, certain mutations, insertions, or deletions of one or more bases in the *attB2* sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the *attB2* sequence are encompassed within the scope of the invention.

A recombinant host cell comprising a nucleic acid molecule containing *attB1* and *attB2* sites (the vector pEXP501, also known as pCMVSPORT6; see Figure 48), *E. coli* DB3.1(pCMVSPORT6), was deposited on February 27, 1999, with the Collection, Agricultural Research Culture Collection (NRRL), 1815 North University Street, Peoria, Illinois 61604 USA, as Deposit No. NRRL B-30108. The *attB1* and *attB2* sites within the deposited nucleic acid molecule are contained in nucleic acid cassettes in association with one or more additional functional sequences as described in more detail below.

In another related aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding *attP1*, or mutants, fragments, variants or derivatives thereof. Such nucleic acid molecules may comprise an *attP1* nucleotide sequence having the sequence set forth in Figure 9, such as: TACAGGTCACCTAATACCATCTAAGTAGTTGATTCATAGTGA-CTGGATATGTTGTGTTTTACAGTATTATGTAGTCTGTTTTTTAT-GCAAAATCTAATTTAATATATTGATATTTATATCATTTTACGTT-TCTCGTTCAGCTTTTTTTGTACAAAGTTGGCATTATAAAAAAGCATTG-CTCATCAATTTGTTGCAACGAACAGGTCACCTATCAGTCAAAATAA-

AATCATTATTTG, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for *attP1*, or mutants, fragments, variants or derivatives thereof. As noted above for *attB1*, certain mutations, insertions, or deletions of one or more bases in the *attP1* sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the *attP1* sequence are encompassed within the scope of the invention.

In another related aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding *attP2*, or mutants, fragments, variants or derivatives thereof. Such nucleic acid molecules may comprise an *attP2* nucleotide sequence having the sequence set forth in Figure 9, such as: CAAATAATGATTTTATTTTGACTGATAGTGACCTGTTCTGTG-CAACAAATTGATAAGCAATGCTTTCTTATAATGCCAACTTT-GTACAAGAAAGCTGAACGAGAAACGTAAAATGATA-TAAATATCAATATATTAAATTAGATTTTGCATAAAAAACAG-ACTACATAATACTGTAAAACACAACATATCCAGTCACTATGAATCAACTACTTAGATGGTATTAGTGACCTGTA, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for *attP2*, or mutants, fragments, variants or derivatives thereof. As noted above for *attB1*, certain mutations, insertions, or deletions of one or more bases in the *attP2* sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the *attP2* sequence are encompassed within the scope of the invention.

A recombinant host cell comprising a nucleic acid molecule (the *attP* vector pDONR201, also known as pENTR21-*attPkan* or pAttPkan; see Figure 49) containing *attP1* and *attP2* sites, *E. coli* DB3.1(pAttPkan) (also called *E. coli* DB3.1(pAHKan)), was deposited on February 27, 1999, with the Collection, Agricultural Research Culture Collection (NRRL), 1815 North University Street, Peoria, Illinois 61604 USA, as Deposit No. NRRL B-30099. The *attP1* and *attP2* sites within the deposited nucleic acid molecule are contained in nucleic acid

cassettes in association with one or more additional functional sequences as described in more detail below.

In another related aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding *attR1*, or mutants, fragments, variants or derivatives thereof. Such nucleic acid molecules may comprise an *attR1* nucleotide sequence having the sequence set forth in Figure 9, such as: ACAAGTTTGTACAAAAAAGCTGAACGAG-AAACGTAAAATGATATAAATATCAATATATTAAATTAGATTTTGCAT-AAAAACAGACTACATAATACTGTAAAACACAACATATCCAGTCA-CTATG, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for *attR1*, or mutants, fragments, variants or derivatives thereof. As noted above for *attB1*, certain mutations, insertions, or deletions of one or more bases in the *attR1* sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the *attR1* sequence are encompassed within the scope of the invention.

In another related aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding *attR2*, or mutants, fragments, variants or derivatives thereof. Such nucleic acid molecules may comprise an *attR2* nucleotide sequence having the sequence set forth in Figure 9, such as: GCAGGTCGACCATAGTGACTGGATAT-GTTGTGTTTTACAGTATTATGTAGTCTGTTTTTTATGCAAATCTA-ATTTAATATATTGATATTTATATCATTTTACGTTTCTCGTTCAGCTT-TCTTGTACAAAGTGGT, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for *attR2*, or mutants, fragments, variants or derivatives thereof. As noted above for *attB1*, certain mutations, insertions, or deletions of one or more bases in the *attR2* sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the *attR2* sequence are encompassed within the scope of the invention.

Recombinant host cell strains containing attR1 sites apposed to cloning sites in reading frame A, reading frame B, and reading frame C, *E. coli* DB3.1(pEZC15101) (reading frame A; see Figure 64A), *E. coli* DB3.1(pEZC15102) (reading frame B; see Figure 64B), and *E. coli* DB3.1(pEZC15103) (reading frame C; see Figure 64C), and containing corresponding attR2 sites, were deposited on February 27, 1999, with the Collection, Agricultural Research Culture Collection (NRRL), 1815 North University Street, Peoria, Illinois 61604 USA, as Deposit Nos. NRRL B-30103, NRRL B-30104, and NRRL B-30105, respectively. The attR1 and attR2 sites within the deposited nucleic acid molecules are contained in nucleic acid cassettes in association with one or more additional functional sequences as described in more detail below.

In another related aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding attL1, or mutants, fragments, variants and derivatives thereof. Such nucleic acid molecules may comprise an attL1 nucleotide sequence having the sequence set forth in Figure 9, such as: CAA ATA ATG ATT TTA TTT TGA CTG ATA GTG ACC TGT TCG TTG CAA CAA ATT GAT AAG CAA TGC TTT TTT ATA ATG CCA ACT TTG TAC AAA AAA GCA GGC T, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for attL1, or mutants, fragments, variants or derivatives thereof. As noted above for attB1, certain mutations, insertions, or deletions of one or more bases in the attL1 sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the attL1 sequence are encompassed within the scope of the invention.

In another related aspect, the invention provides nucleic acid molecules comprising one or more nucleotide sequences encoding attL2, or mutants, fragments, variants and derivatives thereof. Such nucleic acid molecules may comprise an attL2 nucleotide sequence having the sequence set forth in Figure 9, such as: C AAA TAA TGA TTT TAT TTT GAC TGA TAG TGA CCT GTT CGT TGC AAC AAA TTG ATA AGC AAT GCT TTC TTA TAA TGC CAA

CTT TGT ACA AGA AAG CTG GGT, or a nucleotide sequence complementary to the nucleotide sequence set forth in Figure 9 for *attL2*, or mutants, fragments, variants or derivatives thereof. As noted above for *attB1*, certain mutations, insertions, or deletions of one or more bases in the *attL2* sequence contained in the nucleic acid molecules of the invention may be made without compromising the structural and functional integrity of these molecules; hence, nucleic acid molecules comprising such mutations, insertions, or deletions in the *attL2* sequence are encompassed within the scope of the invention.

Recombinant host cell strains containing *attL1* sites apposed to cloning sites in reading frame A, reading frame B, and reading frame C, *E. coli* DB3.1(pENTR1A) (reading frame A; see Figure 10), *E. coli* DB3.1(pENTR2B) (reading frame B; see Figure 11), and *E. coli* DB3.1(pENTR3C) (reading frame C; see Figure 12), and containing corresponding *attL2* sites, were deposited on February 27, 1999, with the Collection, Agricultural Research Culture Collection (NRRL), 1815 North University Street, Peoria, Illinois 61604 USA, as Deposit Nos. NRRL B-30100, NRRL B-30101, and NRRL B-30102, respectively. The *attL1* and *attL2* sites within the deposited nucleic acid molecules are contained in nucleic acid cassettes in association with one or more additional functional sequences as described in more detail below.

Each of the recombination site sequences described herein or portions thereof, or the nucleotide sequence cassettes contained in the deposited clones, may be cloned or inserted into a vector of interest (for example, using the recombinational cloning methods described herein and/or standard restriction cloning techniques that are routine in the art) to generate, for example, Entry Vectors or Destination Vectors which may be used to transfer a desired segment of a nucleic acid molecule of interest (e.g., a gene, cDNA molecule, or cDNA library) into a desired vector or into a host cell.

Using the information provided herein, such as the nucleotide sequences for the recombination site sequences described herein, an isolated nucleic acid molecule of the present invention encoding one or more recombination sites or portions thereof may be obtained using standard cloning and screening procedures, such as those for cloning cDNAs using mRNA as starting material. Preferred such

methods include PCR-based cloning methods, such as reverse transcriptase-PCR (RT-PCR) using primers such as those described herein and in the Examples below. Alternatively, vectors comprising the cassettes containing the recombination site sequences described herein are available commercially from Life Technologies, Inc. (Rockville, MD).

The invention is also directed to nucleic acid molecules comprising one or more of the recombination site sequences or portions thereof and one or more additional nucleotide sequences, which may encode functional or structural sites such as one or more multiple cloning sites, one or more transcription termination sites, one or more transcriptional regulatory sequences (which may be promoters, enhancers, repressors, and the like), one or more translational signals (*e.g.*, secretion signal sequences), one or more origins of replication, one or more fusion partner peptides (particularly glutathione S-transferase (GST), hexahistidine (His₆), and thioredoxin (Trx)), one or more selection markers or modules, one or more nucleotide sequences encoding localization signals such as nuclear localization signals or secretion signals, one or more origins of replication, one or more protease cleavage sites, one or more genes or portions of genes encoding a protein or polypeptide of interest, and one or more 5' polynucleotide extensions (particularly an extension of guanine residues ranging in length from about 1 to about 20, from about 2 to about 15, from about 3 to about 10, from about 4 to about 10, and most preferably an extension of 4 or 5 guanine residues at the 5' end of the recombination site nucleotide sequence. The one or more additional functional or structural sequences may or may not flank one or more of the recombination site sequences contained on the nucleic acid molecules of the invention.

In some nucleic acid molecules of the invention, the one or more nucleotide sequences encoding one or more additional functional or structural sites may be operably linked to the nucleotide sequence encoding the recombination site. For example, certain nucleic acid molecules of the invention may have a promoter sequence operably linked to a nucleotide sequence encoding a recombination site or portion thereof of the invention, such as a T7 promoter, a phage lambda PL

promoter, an *E. coli lac*, *trp* or *tac* promoter, and other suitable promoters which will be familiar to the skilled artisan.

5 Nucleic acid molecules of the present invention, which may be isolated nucleic acid molecules, may be in the form of RNA, such as mRNA, or in the form of DNA, including, for instance, cDNA and genomic DNA obtained by cloning or produced synthetically, or in the form of DNA-RNA hybrids. The nucleic acid molecules of the invention may be double-stranded or single-stranded. Single-stranded DNA or RNA may be the coding strand, also known as the sense strand, or it may be the non-coding strand, also referred to as the anti-sense strand. The nucleic acid molecules of the invention may also have a number of topologies, including linear, circular, coiled, or supercoiled.

10 By "isolated" nucleic acid molecule(s) is intended a nucleic acid molecule, DNA or RNA, which has been removed from its native environment. For example, recombinant DNA molecules contained in a vector are considered isolated for the purposes of the present invention. Further examples of isolated DNA molecules include recombinant DNA molecules maintained in heterologous host cells, and those DNA molecules purified (partially or substantially) from a solution whether produced by recombinant DNA or synthetic chemistry techniques. Isolated RNA molecules include *in vivo* or *in vitro* RNA transcripts of the DNA molecules of the present invention.

20 The present invention further relates to mutants, fragments, variants and derivatives of the nucleic acid molecules of the present invention, which encode portions, analogs or derivatives of one or more recombination sites. Variants may occur naturally, such as a natural allelic variant. By an "allelic variant" is intended one of several alternate forms of a gene occupying a given locus on a chromosome of an organism (*see* Lewin, B., ed., *Genes II*, , John Wiley & Sons, New York (1985)). Non-naturally occurring variants may be produced using art-known mutagenesis techniques, such as those described hereinbelow.

25 Such variants include those produced by nucleotide substitutions, deletions or additions or portions thereof, or combinations thereof. The substitutions, deletions or additions may involve one or more nucleotides. The variants may be altered in coding regions, non-coding regions, or both. Alterations in the coding

regions may produce conservative or non-conservative amino acid substitutions, deletions or additions. Especially preferred among these are silent substitutions, additions and deletions, which do not alter the properties and activities of the encoded polypeptide(s) or portions thereof, and which also do not substantially alter the reactivities of the recombination site nucleic acid sequences in recombination reactions. Also especially preferred in this regard are conservative substitutions.

Particularly preferred mutants, fragments, variants, and derivatives of the nucleic acid molecules of the invention include, but are not limited to, insertions, deletions or substitutions of one or more nucleotide bases within the 15 bp core region (GCTTTTTTATACTAA) which is identical in all four wildtype lambda *att* sites, *attB*, *attP*, *attL* and *attR* (see U.S. Application Nos. 08/663,002, filed June 7, 1996 (now U.S. Patent No. 5,888,732), 09/005,476, filed January 12, 1998, and 09/177,387, filed October 23, 1998, which describes the core region in further detail, and the disclosures of which are incorporated herein by reference in their entireties). Analogously, the core regions in *attB1*, *attP1*, *attL1* and *attR1* are identical to one another, as are the core regions in *attB2*, *attP2*, *attL2* and *attR2*. Particularly preferred in this regard are nucleic acid molecules comprising insertions, deletions or substitutions of one or more nucleotides within the seven bp overlap region (TTTATAC, which is defined by the cut sites for the integrase protein and is the region where strand exchange takes place) that occurs within this 15 bp core region (GCTTTTTTATACTAA). Examples of such preferred mutants, fragments, variants and derivatives according to this aspect of the invention include, but are not limited to, nucleic acid molecules in which the thymine at position 1 of the seven bp overlap region has been deleted or substituted with a guanine, cytosine, or adenine; in which the thymine at position 2 of the seven bp overlap region has been deleted or substituted with a guanine, cytosine, or adenine; in which the thymine at position 3 of the seven bp overlap region has been deleted or substituted with a guanine, cytosine, or adenine; in which the adenine at position 4 of the seven bp overlap region has been deleted or substituted with a guanine, cytosine, or thymine; in which the thymine at position 5 of the seven bp overlap region has been deleted or substituted with a

guanine, cytosine, or adenine; in which the adenine at position 6 of the seven bp overlap region has been deleted or substituted with a guanine, cytosine, or thymine; and in which the cytosine at position 7 of the seven bp overlap region has been deleted or substituted with a guanine, thymine, or adenine; or any combination of one or more such deletions and/or substitutions within this seven bp overlap region. As described in detail in Example 21 herein, mutants of the nucleic acid molecules of the invention in which substitutions have been made within the first three positions of the seven bp overlap (TTTATAC) have been found in the present invention to strongly affect the specificity of recombination, mutant nucleic acid molecules in which substitutions have been made in the last four positions (TTTATAC) only partially alter recombination specificity, and mutant nucleic acid molecules comprising nucleotide substitutions outside of the seven bp overlap, but elsewhere within the 15 bp core region, do not affect specificity of recombination but do influence the efficiency of recombination.

Hence, in an additional aspect, the present invention is also directed to nucleic acid molecules comprising one or more recombination site nucleotide sequences that affect recombination specificity, particularly one or more nucleotide sequences that may correspond substantially to the seven base pair overlap within the 15 bp core region, having one or more mutations that affect recombination specificity. Particularly preferred such molecules may comprise a consensus sequence (described in detail in Example 21 herein) such as NNNATAC, wherein "N" refers to any nucleotide (*i.e.*, may be A, G, T/U or C), with the proviso that if one of the first three nucleotides in the consensus sequence is a T/U, then at least one of the other two of the first three nucleotides is not a T/U.

In a related aspect, the present invention is also directed to nucleic acid molecules comprising one or more recombination site nucleotide sequences that enhance recombination efficiency, particularly one or more nucleotide sequences that may correspond substantially to the core region and having one or more mutations that enhance recombination efficiency. By sequences or mutations that "enhance recombination efficiency" is meant a sequence or mutation in a recombination site, preferably in the core region (*e.g.*, the 15 bp core region of *att* recombination sites), that results in an increase in cloning efficiency (typically

measured by determining successful cloning of a test sequence, *e.g.*, by determining CFU/ml for a given cloning mixture) when recombining molecules comprising the mutated sequence or core region as compared to molecules that do not comprise the mutated sequence or core region (*e.g.*, those comprising a wildtype recombination site core region sequence). More specifically, whether or not a given sequence or mutation enhances recombination efficiency may be determined using the sequence or mutation in recombinational cloning as described herein, and determining whether the sequence or mutation provides enhanced recombinational cloning efficiency when compared to a non-mutated (*e.g.*, wildtype) sequence. Methods of determining preferred cloning efficiency-enhancing mutations for a number of recombination sites, particularly for *att* recombination sites, are described herein, for example in Examples 22-25. Examples of preferred such mutant recombination sites include but are not limited to the *attL* consensus core sequence of caactnntnnnannaagttg (wherein "n" represents any nucleotide), for example the *attL5* sequence agcctgctttattatactaagttggcatta and the *attL6* sequence agcctgcttttttatattaagttggcatta; the *attB1.6* sequence ggggacaactttgtacaaaaagttggct; the *attB2.2* sequence ggggacaactttgtacaagaaagctgggt; and the *attB2.10* sequence ggggacaactttgtacaagaaagttgggt. Those of skill in the art will appreciate that, in addition to the core region, other portions of the *att* site may affect the efficiency of recombination. There are five so-called arm binding sites for the integrase protein in the bacteriophage lambda *attP* site, two in *attR* (P1 and P2), and three in *attL* (P'1, P'2 and P'3). Compared to the core binding sites, the integrase protein binds to arm sites with high affinity and interacts with core and arm sites through two different domains of the protein. As with the core binding site a consensus sequence for the arm binding site consisting of C/AAGTCACTAT has been inferred from sequence comparison of the five arm binding sites and seven non-*att* sites (Ross and Landy, *Proc. Natl. Acad. Sci. USA* 79:7724-7728 (1982)). Each arm site has been mutated and tested for its effect in the excision and integration reactions (Numrych *et al.*, *Nucl. Acids Res.* 18:3953 (1990)). Hence, specific sites are utilized in each reaction in different ways, namely, the P1 and P'3

5 sites are essential for the integration reaction whereas the other three sites are dispensable to the integration reaction to varying degrees. Similarly, the P2, P'1 and P'2 sites are most important for the excision reaction, whereas P1 and P'3 are completely dispensable. Interestingly, when P2 is mutated the integration reaction occurs more efficiently than with the wild type attP site. Similarly, when P1 and P'3 are mutated the excision reaction occurs more efficiently. The stimulatory effect of mutating integrase arm binding sites can be explained by removing sites that compete or inhibit a specific recombination pathway or that function in a reaction that converts products back to starting substrates. In fact there is evidence for an XIS-independent LR reaction (Abremski and Gottesman, *J. Mol. Biol.* 153:67-78 (1981)). Thus, in addition to modifications in the core region of the att site, the present invention contemplates the use of att sites containing one or more modifications in the integrase arm-type binding sites. In some preferred embodiments, one or more mutations may be introduced into one or more of the P1, P'1, P2, P'2 and P'3 sites. In some preferred embodiments, multiple mutations may be introduced into one or more of these sites. Preferred such mutations include those which increase the recombination *in vitro*. For example, in some embodiments mutations may be introduced into the arm-type binding sites such that integrative recombination, corresponding to the BP reaction, is enhanced. In other embodiments, mutations may be introduced into the arm-type binding sites such that excisive recombination, corresponding to the LR reaction, is enhanced. Of course, based on the guidance contained herein, particularly in the construction and evaluation of effects of mutated recombination sites upon recombinational specificity and efficiency, analogous mutated or engineered sequences may be produced for other recombination sites described herein (including but not limited to *lox*, FRT, and the like) and used in accordance with the invention. For example, much like the mutagenesis strategy used to select core binding sites that enhance recombination efficiency, similar strategies can be employed to select changes in the arms of attP, attL and attR, and in analogous sequences in other recombination sites such as *lox*, FRT and the like, that enhance recombination efficiency. Hence, the construction and evaluation of such mutants is well within the abilities of those of ordinary skill in the art without undue experimentation.

One suitable methodology for preparing and evaluating such mutations is found in Numrych, *et al.*, (1990) *Nucleic Acids Research* 18(13): 3953-3959.

Other mutant sequences and nucleic acid molecules that may be suitable to enhance recombination efficiency will be apparent from the description herein, or may be easily determined by one of ordinary skill using only routine experimentation in molecular biology in view of the description herein and information that is readily available in the art

Since the genetic code is well known in the art, it is also routine for one of ordinary skill in the art to produce degenerate variants of the nucleic acid molecules described herein without undue experimentation. Hence, nucleic acid molecules comprising degenerate variants of nucleic acid sequences encoding the recombination sites described herein are also encompassed within the scope of the invention.

Further embodiments of the invention include isolated nucleic acid molecules comprising a polynucleotide having a nucleotide sequence at least 50% identical, at least 60% identical, at least 70% identical, at least 75% identical, at least 80% identical, at least 85% identical, at least 90% identical, and more preferably at least 95%, 96%, 97%, 98% or 99% identical to the nucleotide sequences of the seven bp overlap region within the 15 bp core region of the recombination sites described herein, or the nucleotide sequences of *attB1*, *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* or *attR2* as set forth in Figure 9 (or portions thereof), or a nucleotide sequence complementary to any of these nucleotide sequences, or fragments, variants, mutants, and derivatives thereof.

By a polynucleotide having a nucleotide sequence at least, for example, 95% "identical" to a reference nucleotide sequence encoding a particular recombination site or portion thereof is intended that the nucleotide sequence of the polynucleotide is identical to the reference sequence except that the polynucleotide sequence may include up to five point mutations (*e.g.*, insertions, substitutions, or deletions) per each 100 nucleotides of the reference nucleotide sequence encoding the recombination site. For example, to obtain a polynucleotide having a nucleotide sequence at least 95% identical to a reference *attB1* nucleotide sequence, up to 5% of the nucleotides in the *attB1* reference sequence may be

deleted or substituted with another nucleotide, or a number of nucleotides up to 5% of the total nucleotides in the *attB1* reference sequence may be inserted into the *attB1* reference sequence. These mutations of the reference sequence may occur at the 5' or 3' terminal positions of the reference nucleotide sequence or
5 anywhere between those terminal positions, interspersed either individually among nucleotides in the reference sequence or in one or more contiguous groups within the reference sequence.

As a practical matter, whether any particular nucleic acid molecule is at least 50%, 60%, 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% identical
10 to, for instance, a given recombination site nucleotide sequence or portion thereof can be determined conventionally using known computer programs such as DNAsis software (Hitachi Software, San Bruno, California) for initial sequence alignment followed by ESEE version 3.0 DNA/protein sequence software (cabot@trog.mbb.sfu.ca) for multiple sequence alignments. Alternatively, such
15 determinations may be accomplished using the BESTFIT program (Wisconsin Sequence Analysis Package, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711), which employs a local homology algorithm (Smith and Waterman, *Advances in Applied Mathematics* 2: 482-489 (1981)) to find the best segment of homology between two sequences. When
20 using DNAsis, ESEE, BESTFIT or any other sequence alignment program to determine whether a particular sequence is, for instance, 95% identical to a reference sequence according to the present invention, the parameters are set such that the percentage of identity is calculated over the full length of the reference nucleotide sequence and that gaps in homology of up to 5% of the total number
25 of nucleotides in the reference sequence are allowed.

The present invention is directed to nucleic acid molecules at least 50%, 60%, 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98% or 99% identical to the *attB1*, *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* or *attR2* nucleotide sequences as set forth
30 in Figure 9, or to the nucleotide sequence of the deposited clones, irrespective of whether they encode particular functional polypeptides. This is because even where a particular nucleic acid molecule does not encode a particular functional polypeptide, one of skill in the art would still know how to use the nucleic acid

molecule, for instance, as a hybridization probe or a polymerase chain reaction (PCR) primer.

5 Mutations can also be introduced into the recombination site nucleotide sequences for enhancing site specific recombination or altering the specificities of the reactants, etc. Such mutations include, but are not limited to: recombination sites without translation stop codons that allow fusion proteins to be encoded; recombination sites recognized by the same proteins but differing in base sequence such that they react largely or exclusively with their homologous partners allowing multiple reactions to be contemplated; and mutations that prevent hairpin formation of recombination sites. Which particular reactions take place can be specified by which particular partners are present in the reaction mixture.

10 There are well known procedures for introducing specific mutations into nucleic acid sequences. A number of these are described in Ausubel, F.M. *et al.*, *Current Protocols in Molecular Biology*, Wiley Interscience, New York (1989-1996). Mutations can be designed into oligonucleotides, which can be used to modify existing cloned sequences, or in amplification reactions. Random mutagenesis can also be employed if appropriate selection methods are available to isolate the desired mutant DNA or RNA. The presence of the desired mutations can be confirmed by sequencing the nucleic acid by well known methods.

20 The following non-limiting methods can be used to modify or mutate a given nucleic acid molecule encoding a particular recombination site to provide mutated sites that can be used in the present invention:

- 25 1. By recombination of two parental DNA sequences by site-specific (e.g. attL and attR to give attP) or other (e.g. homologous) recombination mechanisms where the parental DNA segments contain one or more base alterations resulting in the final mutated nucleic acid molecule;
2. By mutation or mutagenesis (site-specific, PCR, random, spontaneous, etc) directly of the desired nucleic acid molecule;
- 30 3. By mutagenesis (site-specific, PCR, random, spontaneous, etc) of parental DNA sequences, which are recombined to generate a desired nucleic acid molecule;

4. By reverse transcription of an RNA encoding the desired core sequence;
and
5. By *de novo* synthesis (chemical synthesis) of a sequence having the desired
base changes, or random base changes followed by sequencing or
functional analysis according to methods that are routine in the art.

The functionality of the mutant recombination sites can be demonstrated in ways that depend on the particular characteristic that is desired. For example, the lack of translation stop codons in a recombination site can be demonstrated by expressing the appropriate fusion proteins. Specificity of recombination between homologous partners can be demonstrated by introducing the appropriate molecules into *in vitro* reactions, and assaying for recombination products as described herein or known in the art. Other desired mutations in recombination sites might include the presence or absence of restriction sites, translation or transcription start signals, protein binding sites, particular coding sequences, and other known functionalities of nucleic acid base sequences. Genetic selection schemes for particular functional attributes in the recombination sites can be used according to known method steps. For example, the modification of sites to provide (from a pair of sites that do not interact) partners that do interact could be achieved by requiring deletion, via recombination between the sites, of a DNA sequence encoding a toxic substance. Similarly, selection for sites that remove translation stop sequences, the presence or absence of protein binding sites, etc., can be easily devised by those skilled in the art.

Accordingly, the present invention also provides a nucleic acid molecule, comprising at least one DNA segment having at least one, and preferably at least two, engineered recombination site nucleotide sequences of the invention flanking a selectable marker and/or a desired DNA segment, wherein at least one of said recombination site nucleotide sequences has at least one engineered mutation that enhances recombination *in vitro* in the formation of a Cointegrate DNA or a Product DNA. Such engineered mutations may be in the core sequence of the recombination site nucleotide sequence of the invention; *see* U.S. Application Nos. 08/486,139, filed June 7, 1995, 08/663,002, filed June 7, 1996 (now U.S. Patent No. 5,888,732), 09/005,476, filed January 12, 1998, and 09/177,387, filed

October 23, 1998, the disclosures of which are all incorporated herein by reference in their entireties.

While in the preferred embodiment the recombination sites differ in sequence and do not interact with each other, it is recognized that sites comprising the same sequence, which may interact with each other, can be manipulated or engineered to inhibit recombination with each other. Such conceptions are considered and incorporated herein. For example, a protein binding site (*e.g.*, an antibody-binding site, a histone-binding site, an enzyme-binding site, or a binding site for any nucleic acid molecule-binding protein) can be engineered adjacent to one of the sites. In the presence of the protein that recognizes the engineered site, the recombinase fails to access the site and another recombination site in the nucleic acid molecule is therefore used preferentially. In the cointegrate this site can no longer react since it has been changed, *e.g.*, from attB to attL. During or upon resolution of the cointegrate, the protein can be inactivated (*e.g.*, by antibody, heat or a change of buffer) and the second site can undergo recombination.

The nucleic acid molecules of the invention can have at least one mutation that confers at least one enhancement of said recombination, said enhancement selected from the group consisting of substantially (i) favoring integration; (ii) favoring recombination; (iii) relieving the requirement for host factors; (iv) increasing the efficiency of said Cointegrate DNA or Product DNA formation; (v) increasing the specificity of said Cointegrate DNA or Product DNA formation; and (vi) adding or deleting protein binding sites.

In other embodiments, the nucleic acid molecules of the invention may be PCR primer molecules, which comprise one or more of the recombination site sequences described herein or portions thereof, particularly those shown in Figure 9 (or sequences complementary to those shown in Figure 9), or mutants, fragments, variants or derivatives thereof, attached at the 3' end to a target-specific template sequence which specifically interacts with a target nucleic acid molecule which is to be amplified. Primer molecules according to this aspect of the invention may further comprise one or more, (*e.g.*, 1, 2, 3, 4, 5, 10, 20, 25, 50, 100, 500, 1000, or more) additional bases at their 5' ends, and preferably comprise one or more (particularly four or five) additional bases, which are preferably

guanines, at their 5' ends, to increase the efficiency of the amplification products incorporating the primer molecules in the recombinational cloning system of the invention. Such nucleic acid molecules and primers are described in detail in the examples herein, particularly in Examples 22-25.

5 Certain primers of the invention may comprise one or more nucleotide deletions in the *attB1*, *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* or *attR2* sequences as set forth in Figure 9. In one such aspect, for example, *attB2* primers may be constructed in which one or more of the first four nucleotides at the 5' end of the *attB2* sequence shown in Figure 9 have been deleted. Primers according to this aspect of the invention may therefore have the sequence:

10 (*attB2*(-1)): CCCAGCTTTCTTGTACAAAGTGGTnnnnnnnnnnnnnn . . . n

(*attB2*(-2)): CCAGCTTTCTTGTACAAAGTGGTnnnnnnnnnnnnnn . . . n

(*attB2*(-3)): CAGCTTTCTTGTACAAAGTGGTnnnnnnnnnnnnnn . . . n

(*attB2*(-4)): AGCTTTCTTGTACAAAGTGGTnnnnnnnnnnnnnn . . . n,

15 wherein "nnnnnnnnnnnn . . . n" at the 3' end of the primer represents a target-specific sequence of any length, for example from one base up to all of the bases of a target nucleic acid molecule (e.g., a gene) or a portion thereof, the sequence and length which will depend upon the identity of the target nucleic acid molecule which is to be amplified.

20 The primer nucleic acid molecules according to this aspect of the invention may be produced synthetically by attaching the recombination site sequences depicted in Figure 9, or portions thereof, to the 5' end of a standard PCR target-specific primer according to methods that are well-known in the art. Alternatively, additional primer nucleic acid molecules of the invention may be produced synthetically by adding one or more nucleotide bases, which preferably correspond to one or more, preferably five or more, and more preferably six or more, contiguous nucleotides of the *att* nucleotide sequences described herein (see, e.g., Example 20 herein; see also U.S. Application Nos. 08/663,002, filed June 7, 1996 (now U.S. Patent No. 5,888,732), 09/005,476, filed January 12, 1998, and 09/177,387, filed October 23, 1998, the disclosures of which are all incorporated herein by reference in their entireties), to the 5' end of a standard PCR target-specific primer according to methods that are well-known in the art, to provide

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primers having the specific nucleotide sequences described herein. As noted above, primer nucleic acid molecules according to this aspect of the invention may also optionally comprise one, two, three, four, five, or more additional nucleotide bases at their 5' ends, and preferably will comprise four or five guanines at their 5' ends. In one particularly preferred such aspect, the primer nucleic acid molecules of the invention may comprise one or more, preferably five or more, more preferably six or more, still more preferably 6-18 or 6-25, and most preferably 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24 or 25, contiguous nucleotides or bp of the *attB1* or *attB2* nucleotide sequences depicted in Figure 9 (or nucleotides complementary thereto), linked to the 5' end of a target-specific (*e.g.*, a gene-specific) primer molecule. Primer nucleic acid molecules according to this aspect of the invention include, but are not limited to, *attB1*- and *attB2*-derived primer nucleic acid molecules having the following nucleotide sequences:

ACAAGTTTGTACAAAAAAGCAGGCT-nnnnnnnnnnnnn . . . n
ACCACTTTGTACAAGAAAGCTGGGT-nnnnnnnnnnnnn . . . n
TGTACAAAAAAGCAGGCT-nnnnnnnnnnnnn . . . n
TGTACAAGAAAGCTGGGT-nnnnnnnnnnnnn . . . n
ACAAAAAAGCAGGCT-nnnnnnnnnnnnn . . . n
ACAAGAAAGCTGGGT-nnnnnnnnnnnnn . . . n
AAAAAGCAGGCT-nnnnnnnnnnnnn . . . n
AGAAAGCTGGGT-nnnnnnnnnnnnn . . . n
AAAAGCAGGCT-nnnnnnnnnnnnn . . . n
GAAAGCTGGGT-nnnnnnnnnnnnn . . . n
AAAGCAGGCT-nnnnnnnnnnnnn . . . n
AAAGCTGGGT-nnnnnnnnnnnnn . . . n
AAGCAGGCT-nnnnnnnnnnnnn . . . n
AAGCTGGGT-nnnnnnnnnnnnn . . . n
AGCAGGCT-nnnnnnnnnnnnn . . . n
AGCTGGGT-nnnnnnnnnnnnn . . . n
GCAGGCT-nnnnnnnnnnnnn . . . n
GCTGGGT-nnnnnnnnnnnnn . . . n

CAGGCT-nnnnnnnnnnnnn . . . n

CTGGGT-nnnnnnnnnnnnn . . . n,

wherein "nnnnnnnnnnnn . . . n" at the 3' end of the primer represents a target-specific sequence of any length, for example from one base up to all of the bases of a target nucleic acid molecule (e.g., a gene) or a portion thereof, the sequence and length which will depend upon the identity of the target nucleic acid molecule which is to be amplified.

Of course, it will be apparent to one of ordinary skill from the teachings contained herein that additional primer nucleic acid molecules analogous to those specifically described herein may be produced using one or more, preferably five or more, more preferably six or more, still more preferably ten or more, 15 or more, 20 or more, 25 or more, 30 or more, etc. (through to and including all) of the contiguous nucleotides or bp of the *attP1*, *attP2*, *attL1*, *attL2*, *attR1* or *attR2* nucleotide sequences depicted in Figure 9 (or nucleotides complementary thereto), linked to the 5' end of a target-specific (e.g., a gene-specific) primer molecule. As noted above, such primer nucleic acid molecules may optionally further comprise one, two, three, four, five, or more additional nucleotide bases at their 5' ends, and preferably will comprise four guanines at their 5' ends. Other primer molecules comprising the *attB1*, *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* and *attR2* sequences depicted in Figure 9, or portions thereof, may be made by one of ordinary skill without resorting to undue experimentation in accordance with the guidance provided herein.

The primers of the invention described herein are useful in producing PCR fragments having a nucleic acid molecule of interest flanked at each end by a recombination site sequence (as described in detail below in Example 9), for use in cloning of PCR-amplified DNA fragments using the recombination system of the invention (as described in detail below in Examples 8, 19 and 21-25).

Vectors

The invention also relates to vectors comprising one or more of the nucleic acid molecules of the invention, as described herein. In accordance with the invention, any vector may be used to construct the vectors of the invention. In

particular, vectors known in the art and those commercially available (and variants or derivatives thereof) may in accordance with the invention be engineered to include one or more nucleic acid molecules encoding one or more recombination sites (or portions thereof), or mutants, fragments, or derivatives thereof, for use in the methods of the invention. Such vectors may be obtained from, for example, Vector Laboratories Inc., InVitrogen, Promega, Novagen, New England Biolabs, Clontech, Roche, Pharmacia, EpiCenter, OriGenes Technologies Inc., Stratagene, Perkin Elmer, Pharmingen, Life Technologies, Inc., and Research Genetics. Such vectors may then for example be used for cloning or subcloning nucleic acid molecules of interest. General classes of vectors of particular interest include prokaryotic and/or eukaryotic cloning vectors, Expression Vectors, fusion vectors, two-hybrid or reverse two-hybrid vectors, shuttle vectors for use in different hosts, mutagenesis vectors, transcription vectors, vectors for receiving large inserts and the like.

Other vectors of interest include viral origin vectors (M13 vectors, bacterial phage λ vectors, bacteriophage P1 vectors, adenovirus vectors, herpesvirus vectors, retrovirus vectors, phage display vectors, combinatorial library vectors), high, low, and adjustable copy number vectors, vectors which have compatible replicons for use in combination in a single host (pACYC184 and pBR322) and eukaryotic episomal replication vectors (pCDM8).

Particular vectors of interest include prokaryotic Expression Vectors such as pcDNA II, pSL301, pSE280, pSE380, pSE420, pTrcHisA, B, and C, pRSET A, B, and C (Invitrogen, Inc.), pGEMEX-1, and pGEMEX-2 (Promega, Inc.), the pET vectors (Novagen, Inc.), pTrc99A, pKK223-3, the pGEX vectors, pEZZ18, pRIT2T, and pMC1871 (Pharmacia, Inc.), pKK233-2 and pKK388-1 (Clontech, Inc.), and pProEx-HT (Life Technologies, Inc.) and variants and derivatives thereof. Destination Vectors can also be made from eukaryotic Expression Vectors such as pFastBac, pFastBac HT, pFastBac DUAL, pSFV, and pTet-Splice (Life Technologies, Inc.), pEUK-C1, pPUR, pMAM, pMAMneo, pBI101, pBI121, pDR2, pCMVEBNA, and pYACneo (Clontech), pSVK3, pSVL, pMSG, pCH110, and pKK232-8 (Pharmacia, Inc.), p3'SS, pXT1, pSG5, pPbac, pMbac, pMC1neo, and pOG44 (Stratagene, Inc.), and pYES2, pAC360, pBlueBacHis A,

B, and C, pVL1392, pBsueBacIII, pCDM8, pcDNA1, pZeoSV, pcDNA3 pREP4, pCEP4, and pEBVHis (Invitrogen, Inc.) and variants or derivatives thereof.

Other vectors of particular interest include pUC18, pUC19, pBlueScript, pSPORT, cosmids, phagemids, YACs (yeast artificial chromosomes), BACs (bacterial artificial chromosomes), MACs (mammalian artificial chromosomes), pQE70, pQE60, pQE9 (Quiagen), pBS vectors, PhageScript vectors, BlueScript vectors, pNH8A, pNH16A, pNH18A, pNH46A (Stratagene), pcDNA3 (Invitrogen), pGEX, pTrsfus, pTrc99A, pET-5, pET-9, pKK223-3, pKK233-3, pDR540, pRIT5 (Pharmacia), pSPORT1, pSPORT2, pCMVSPORT2.0 and pSV-SPORT1 (Life Technologies, Inc.) and variants or derivatives thereof.

Additional vectors of interest include pTrxFus, pThioHis, pLEX, pTrcHis, pTrcHis2, pRSET, pBlueBacHis2, pcDNA3.1/His, pcDNA3.1(-)/Myc-His, pSecTag, pEBVHis, pPIC9K, pPIC3.5K, pAO815, pPICZ, pPICZ α , pGAPZ, pGAPZ α , pBlueBac4.5, pBlueBacHis2, pMelBac, pSinRep5, pSinHis, pIND, pIND(SP1), pVgRXR, pcDNA2.1, pYES2, pZErO1.1, pZErO-2.1, pCR-Blunt, pSE280, pSE380, pSE420, pVL1392, pVL1393, pCDM8, pcDNA1.1, pcDNA1.1/Amp, pcDNA3.1, pcDNA3.1/Zeo, pSe,SV2, pRc/CMV2, pRc/RSV, pREP4, pREP7, pREP8, pREP9, pREP10, pCEP4, pEBVHis, pCR3.1, pCR2.1, pCR3.1-Uni, and pCRBac from Invitrogen; λ ExCell, λ gt11, pTrc99A, pKK223-3, pGEX-1 λ T, pGEX-2T, pGEX-2TK, pGEX-4T-1, pGEX-4T-2, pGEX-4T-3, pGEX-3X, pGEX-5X-1, pGEX-5X-2, pGEX-5X-3, pEZZ18, pRIT2T, pMC1871, pSVK3, pSVL, pMSG, pCH110, pKK232-8, pSL1180, pNEO, and pUC4K from Pharmacia; pSCREEN-1b(+), pT7Blue(R), pT7Blue-2, pCITE-4abc(+), pOCUS-2, pTag, pET-32 LIC, pET-30 LIC, pBAC-2cp LIC, pBACgus-2cp LIC, pT7Blue-2 LIC, pT7Blue-2, λ SCREEN-1, λ BlueSTAR, pET-3abcd, pET-7abc, pET9abcd, pET11abcd, pET12abc, pET-14b, pET-15b, pET-16b, pET-17b-pET-17xb, pET-19b, pET-20b(+), pET-21abcd(+), pET-22b(+), pET-23abcd(+), pET-24abcd(+), pET-25b(+), pET-26b(+), pET-27b(+), pET-28abc(+), pET-29abc(+), pET-30abc(+), pET-31b(+), pET-32abc(+), pET-33b(+), pBAC-1, pBACgus-1, pBAC4x-1, pBACgus4x-1, pBAC-3cp, pBACgus-2cp, pBACsurf-1, plg, Signal plg, pYX, Selecta Vecta-Neo, Selecta Vecta - Hyg, and Selecta Vecta - Gpt from Novagen; pLexA, pB42AD, pGBT9, pAS2-1,

pGAD424, pACT2, pGAD GL, pGAD GH, pGAD10, pGilda, pEZM3, pEGFP, pEGFP-1, pEGFP-N, pEGFP-C, pEBFP, pGFPuv, pGFP, p6xHis-GFP, pSEAP2-Basic, pSEAP2-Contral, pSEAP2-Promoter, pSEAP2-Enhancer, p β gal-Basic, p β gal-Control, p β gal-Promoter, p β gal-Enhancer, pCMV β , pTet-Off, pTet-On, pTK-Hyg, pRetro-Off, pRetro-On, pIRES1neo, pIRES1hyg, pLXSN, pLNCX, pLAPSN, pMAMneo, pMAMneo-CAT, pMAMneo-LUC, pPUR, pSV2neo, pYEX 4T-1/2/3, pYEX-S1, pBacPAK-His, pBacPAK8/9, pAcUW31, BacPAK6, pTriplEx, λ gt10, λ gt11, pWE15, and λ TriplEx from Clontech; Lambda ZAP II, pBK-CMV, pBK-RSV, pBluescript II KS +/-, pBluescript II SK +/-, pAD-GAL4, pBD-GAL4 Cam, pSurfscrip, Lambda FIX II, Lambda DASH, Lambda EMBL3, Lambda EMBL4, SuperCos, pCR-Script Amp, pCR-Script Cam, pCR-Script Direct, pBS +/-, pBC KS +/-, pBC SK +/-, Phagescript, pCAL-n-EK, pCAL-n, pCAL-c, pCAL-kc, pET-3abcd, pET-11abcd, pSPUTK, pESP-1, pCMVLacI, pOPRSVI/MCS, pOPI3 CAT, pXT1, pSG5, pPbac, pMbac, pMC1neo, pMC1neo Poly A, pOG44, pOG45, pFRT β GAL, pNEO β GAL, pRS403, pRS404, pRS405, pRS406, pRS413, pRS414, pRS415, and pRS416 from Stratagene.

Two-hybrid and reverse two-hybrid vectors of particular interest include pPC86, pDBLeu, pDBTrp, pPC97, p2.5, pGAD1-3, pGAD10, pAct, pACT2, pGADGL, pGADGH, pAS2-1, pGAD424, pGBT8, pGBT9, pGAD-GAL4, pLexA, pBD-GAL4, pHISi, pHISi-1, placZi, pB42AD, pDG202, pJK202, pJG4-5, pNLexA, pYESTrp and variants or derivatives thereof.

Yeast Expression Vectors of particular interest include pESP-1, pESP-2, pESC-His, pESC-Trp, pESC-URA, pESC-Leu (Stratagene), pRS401, pRS402, pRS411, pRS412, pRS421, pRS422, and variants or derivatives thereof.

According to the invention, the vectors comprising one or more nucleic acid molecules encoding one or more recombination sites, or mutants, variants, fragments, or derivatives thereof, may be produced by one of ordinary skill in the art without resorting to undue experimentation using standard molecular biology methods. For example, the vectors of the invention may be produced by introducing one or more of the nucleic acid molecules encoding one or more recombination sites (or mutants, fragments, variants or derivatives thereof) into one or more of the vectors described herein, according to the methods described,

for example, in Maniatis *et al.*, *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor Laboratory, Cold Spring Harbor, New York (1982). In a related aspect of the invention, the vectors may be engineered to contain, in addition to one or more nucleic acid molecules encoding one or more recombination sites (or portions thereof), one or more additional physical or functional nucleotide sequences, such as those encoding one or more multiple cloning sites, one or more transcription termination sites, one or more transcriptional regulatory sequences (e.g., one or more promoters, enhancers, or repressors), one or more selection markers or modules, one or more genes or portions of genes encoding a protein or polypeptide of interest, one or more translational signal sequences, one or more nucleotide sequences encoding a fusion partner protein or peptide (e.g., GST, His₆, or thioredoxin), one or more origins of replication, and one or more 5' or 3' polynucleotide tails (particularly a poly-G tail). According to this aspect of the invention, the one or more recombination site nucleotide sequences (or portions thereof) may optionally be operably linked to the one or more additional physical or functional nucleotide sequences described herein.

Preferred vectors according to this aspect of the invention include, but are not limited to: pENTR1A (Figures 10A and 10B), pENTR2B (Figures 11A and 11B), pENTR3C (Figures 12A and 12B), pENTR4 (Figures 13A and 13B), pENTR5 (Figures 14A and 14B), pENTR6 (Figures 15A and 15B), pENTR7 (Figures 16A and 16B), pENTR8 (Figures 17A and 17B), pENTR9 (Figures 18A and 18B), pENTR10 (Figures 19A and 19B), pENTR11 (Figures 20A and 20B), pDEST1 (Figures 21A-D), pDEST2 (Figure 22A-D), pDEST3 (Figure 23A-D), pDEST4 (Figure 24A-D), pDEST5 (Figure 25A-D), pDEST6 (Figure 26A-D), pDEST7 (Figure 27A-C), pDEST8 (Figure 28A-D), pDEST9 (Figure 29A-E), pDEST10 (Figure 30A-D), pDEST11 (Figure 31A-D), pDEST12.2 (also known as pDEST12) (Figure 32A-D), pDEST13 (Figure 33A-C), pDEST14 (Figure 34A-D), pDEST15 (Figure 35A-D), pDEST16 (Figure 36A-D), pDEST17 (Figure 37A-D), pDEST18 (Figure 38A-D), pDEST19 (Figure 39A-D), pDEST20 (Figure 40A-D), pDEST21 (Figure 41A-E), pDEST22 (Figure 42A-D), pDEST23 (Figure 43A-D), pDEST24 (Figure 44A-D), pDEST25 (Figure 45A-D), pDEST26 (Figure 46A-D), pDEST27 (Figure 47A-D), pEXP501 (also known

as pCMVSPORT6) (Figure 48A-B), pDONR201 (also known as pENTR21 attP vector or pAttPkan Donor Vector) (Figure 49), pDONR202 (Figure 50), pDONR203 (also known as pEZ15812) (Figure 51), pDONR204 (Figure 52), pDONR205 (Figure 53), pDONR206 (also known as pENTR22 attP vector or pAttPgen Donor Vector) (Figure 54), pMAB58 (Figure 87), pMAB62 (Figure 88), pDEST28 (Figure 90), pDEST29 (Figure 91), pDEST30 (Figure 92), pDEST31 (Figure 93), pDEST32 (Figure 94), pDEST33 (Figure 95), pDEST34 (Figure 96), pDONR207 (Figure 97), pMAB85 (Figure 98), pMAB86 (Figure 99), and fragments, mutants, variants, and derivatives thereof. However, it will be understood by one of ordinary skill that the present invention also encompasses other vectors not specifically designated herein, which comprise one or more of the isolated nucleic acid molecules of the invention encoding one or more recombination sites or portions thereof (or mutants, fragments, variants or derivatives thereof), and which may further comprise one or more additional physical or functional nucleotide sequences described herein which may optionally be operably linked to the one or more nucleic acid molecules encoding one or more recombination sites or portions thereof. Such additional vectors may be produced by one of ordinary skill according to the guidance provided in the present specification.

Polymerases

Preferred polypeptides having reverse transcriptase activity (*i.e.*, those polypeptides able to catalyze the synthesis of a DNA molecule from an RNA template) for use in accordance with the present invention include, but are not limited to Moloney Murine Leukemia Virus (M-MLV) reverse transcriptase, Rous Sarcoma Virus (RSV) reverse transcriptase, Avian Myeloblastosis Virus (AMV) reverse transcriptase, Rous Associated Virus (RAV) reverse transcriptase, Myeloblastosis Associated Virus (MAV) reverse transcriptase, Human Immunodeficiency Virus (HIV) reverse transcriptase, retroviral reverse transcriptase, retrotransposon reverse transcriptase, hepatitis B reverse transcriptase, cauliflower mosaic virus reverse transcriptase and bacterial reverse transcriptase. Particularly preferred are those polypeptides having reverse

transcriptase activity that are also substantially reduced in RNase H activity (*i.e.*, “RNase H” polypeptides). By a polypeptide that is “substantially reduced in RNase H activity” is meant that the polypeptide has less than about 20%, more preferably less than about 15%, 10% or 5%, and most preferably less than about 2%, of the RNase H activity of a wildtype or RNase H⁺ enzyme such as wildtype M-MLV reverse transcriptase. The RNase H activity may be determined by a variety of assays, such as those described, for example, in U.S. Patent No. 5,244,797, in Kotewicz, M.L. *et al.*, *Nucl. Acids Res.* 16:265 (1988) and in Gerard, G.F., *et al.*, *FOCUS* 14(5):91 (1992), the disclosures of all of which are fully incorporated herein by reference. Suitable RNase H⁺ polypeptides for use in the present invention include, but are not limited to, M-MLV H⁺ reverse transcriptase, RSV H⁺ reverse transcriptase, AMV H⁺ reverse transcriptase, RAV H⁺ reverse transcriptase, MAV H⁺ reverse transcriptase, HIV H⁺ reverse transcriptase, THERMOSCRIPT™ reverse transcriptase and THERMOSCRIPT™ II reverse transcriptase, and SUPERScript™ I reverse transcriptase and SUPERScript™ II reverse transcriptase, which are obtainable, for example, from Life Technologies, Inc. (Rockville, Maryland). See generally published PCT application WO 98/47912.

Other polypeptides having nucleic acid polymerase activity suitable for use in the present methods include thermophilic DNA polymerases such as DNA polymerase I, DNA polymerase III, Klenow fragment, T7 polymerase, and T5 polymerase, and thermostable DNA polymerases including, but not limited to, *Thermus thermophilus* (*Tth*) DNA polymerase, *Thermus aquaticus* (*Taq*) DNA polymerase, *Thermotoga neopolitana* (*Tne*) DNA polymerase, *Thermotoga maritima* (*Tma*) DNA polymerase, *Thermococcus litoralis* (*Tli* or VENT®) DNA polymerase, *Pyrococcus furiosus* (*Pfu*) DNA polymerase, *Pyrococcus* species GB-D (or DEEPVENT®) DNA polymerase, *Pyrococcus woosii* (*Pwo*) DNA polymerase, *Bacillus stearothermophilus* (*Bst*) DNA polymerase, *Sulfolobus acidocaldarius* (*Sac*) DNA polymerase, *Thermoplasma acidophilum* (*Tac*) DNA polymerase, *Thermus flavus* (*Tfl/Tub*) DNA polymerase, *Thermus ruber* (*Tru*) DNA polymerase, *Thermus brockianus* (DYNAZYME®) DNA polymerase, *Methanobacterium thermoautotrophicum* (*Mth*) DNA polymerase, and mutants,

variants and derivatives thereof. Such polypeptides are available commercially, for example from Life Technologies, Inc. (Rockville, MD), New Englan BioLabs (Beverly, MA), and Sigma/Aldrich (St. Louis, MO).

Host Cells

The invention also relates to host cells comprising one or more of the nucleic acid molecules or vectors of the invention, particularly those nucleic acid molecules and vectors described in detail herein. Representative host cells that may be used according to this aspect of the invention include, but are not limited to, bacterial cells, yeast cells, plant cells and animal cells. Preferred bacterial host cells include *Escherichia* spp. cells (particularly *E. coli* cells and most particularly *E. coli* strains DH10B, Stbl2, DH5 α , DB3, DB3.1 (preferably *E. coli* LIBRARY EFFICIENCY \circledR DB3.1TM Competent Cells; Life Technologies, Inc., Rockville, MD), DB4 and DB5; see U.S. Provisional Application No. 60/122,392, filed on March 2, 1999, the disclosure of which is incorporated by reference herein in its entirety), *Bacillus* spp. cells (particularly *B. subtilis* and *B. megaterium* cells), *Streptomyces* spp. cells, *Erwinia* spp. cells, *Klebsiella* spp. cells, *Serratia* spp. cells (particularly *S. marcessans* cells), *Pseudomonas* spp. cells (particularly *P. aeruginosa* cells), and *Salmonella* spp. cells (particularly *S. typhimurium* and *S. typhi* cells). Preferred animal host cells include insect cells (most particularly *Drosophila melanogaster* cells, *Spodoptera frugiperda* Sf9 and Sf21 cells and *Trichoplusa* High-Five cells), nematode cells (particularly *C. elegans* cells), avian cells, amphibian cells (particularly *Xenopus laevis* cells), reptilian cells, and mammalian cells (most particularly CHO, COS, VERO, BHK and human cells). Preferred yeast host cells include *Saccharomyces cerevisiae* cells and *Pichia pastoris* cells. These and other suitable host cells are available commercially, for example from Life Technologies, Inc. (Rockville, Maryland), American Type Culture Collection (Manassas, Virginia), and Agricultural Research Culture Collection (NRRL; Peoria, Illinois).

Methods for introducing the nucleic acid molecules and/or vectors of the invention into the host cells described herein, to produce host cells comprising one or more of the nucleic acid molecules and/or vectors of the invention, will be

familiar to those of ordinary skill in the art. For instance, the nucleic acid molecules and/or vectors of the invention may be introduced into host cells using well known techniques of infection, transduction, transfection, and transformation. The nucleic acid molecules and/or vectors of the invention may be introduced
5 alone or in conjunction with other the nucleic acid molecules and/or vectors. Alternatively, the nucleic acid molecules and/or vectors of the invention may be introduced into host cells as a precipitate, such as a calcium phosphate precipitate, or in a complex with a lipid. Electroporation also may be used to introduce the nucleic acid molecules and/or vectors of the invention into a host. Likewise, such
10 molecules may be introduced into chemically competent cells such as *E. coli*. If the vector is a virus, it may be packaged *in vitro* or introduced into a packaging cell and the packaged virus may be transduced into cells. Hence, a wide variety of techniques suitable for introducing the nucleic acid molecules and/or vectors of the invention into cells in accordance with this aspect of the invention are well
15 known and routine to those of skill in the art. Such techniques are reviewed at length, for example, in Sambrook, J., *et al.*, *Molecular Cloning, a Laboratory Manual, 2nd Ed.*, Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, pp. 16.30-16.55 (1989), Watson, J.D., *et al.*, *Recombinant DNA, 2nd Ed.*, New York: W.H. Freeman and Co., pp. 213-234 (1992), and Winnacker, E.-L.,
20 *From Genes to Clones*, New York: VCH Publishers (1987), which are illustrative of the many laboratory manuals that detail these techniques and which are incorporated by reference herein in their entireties for their relevant disclosures.

Polypeptides

25 In another aspect, the invention relates to polypeptides encoded by the nucleic acid molecules of the invention (including polypeptides and amino acid sequences encoded by all possible reading frames of the nucleic acid molecules of the invention), and to methods of producing such polypeptides. Polypeptides of the present invention include purified or isolated natural products, products of
30 chemical synthetic procedures, and products produced by recombinant techniques from a prokaryotic or eukaryotic host, including, for example, bacterial, yeast, insect, mammalian, avian and higher plant cells.

The polypeptides of the invention may be produced by synthetic organic chemistry, and are preferably produced by standard recombinant methods, employing one or more of the host cells of the invention comprising the vectors or isolated nucleic acid molecules of the invention. According to the invention, polypeptides are produced by cultivating the host cells of the invention (which comprise one or more of the nucleic acid molecules of the invention, preferably contained within an Expression Vector) under conditions favoring the expression of the nucleotide sequence contained on the nucleic acid molecule of the invention, such that the polypeptide encoded by the nucleic acid molecule of the invention is produced by the host cell. As used herein, "conditions favoring the expression of the nucleotide sequence" or "conditions favoring the production of a polypeptide" include optimal physical (e.g., temperature, humidity, etc.) and nutritional (e.g., culture medium, ionic) conditions required for production of a recombinant polypeptide by a given host cell. Such optimal conditions for a variety of host cells, including prokaryotic (bacterial), mammalian, insect, yeast, and plant cells will be familiar to one of ordinary skill in the art, and may be found, for example, in Sambrook, J., *et al.*, *Molecular Cloning, A Laboratory Manual, 2nd Ed.*, Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, (1989), Watson, J.D., *et al.*, *Recombinant DNA, 2nd Ed.*, New York: W.H. Freeman and Co., and Winnacker, E.-L., *From Genes to Clones*, New York: VCH Publishers (1987).

In some aspects, it may be desirable to isolate or purify the polypeptides of the invention (e.g., for production of antibodies as described below), resulting in the production of the polypeptides of the invention in isolated form. The polypeptides of the invention can be recovered and purified from recombinant cell cultures by well-known methods of protein purification that are routine in the art, including ammonium sulfate or ethanol precipitation, acid extraction, anion or cation exchange chromatography, phosphocellulose chromatography, hydrophobic interaction chromatography, affinity chromatography, hydroxylapatite chromatography and lectin chromatography. For example, His6 or GST fusion tags on polypeptides made by the methods of the invention may be isolated using appropriate affinity chromatography matrices which bind polypeptides bearing

His6 or GST tags, as will be familiar to one of ordinary skill in the art. Polypeptides of the present invention include naturally purified products, products of chemical synthetic procedures, and products produced by recombinant techniques from a prokaryotic or eukaryotic host, including, for example, bacterial, yeast, higher plant, insect and mammalian cells. Depending upon the host employed in a recombinant production procedure, the polypeptides of the present invention may be glycosylated or may be non-glycosylated. In addition, polypeptides of the invention may also include an initial modified methionine residue, in some cases as a result of host-mediated processes.

Isolated polypeptides of the invention include those comprising the amino acid sequences encoded by one or more of the reading frames of the polynucleotides comprising one or more of the recombination site-encoding nucleic acid molecules of the invention, including those encoding *attB1*, *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* and *attR2* having the nucleotide sequences set forth in Figure 9 (or nucleotide sequences complementary thereto), or fragments, variants, mutants and derivatives thereof; the complete amino acid sequences encoded by the polynucleotides contained in the deposited clones described herein; the amino acid sequences encoded by polynucleotides which hybridize under stringent hybridization conditions to polynucleotides having the nucleotide sequences encoding the recombination site sequences of the invention as set forth in Figure 9 (or a nucleotide sequence complementary thereto); or a peptide or polypeptide comprising a portion or a fragment of the above polypeptides. The invention also relates to additional polypeptides having one or more additional amino acids linked (typically by peptidyl bonds to form a nascent polypeptide) to the polypeptides encoded by the recombination site nucleotide sequences or the deposited clones. Such additional amino acid residues may comprise one or more functional peptide sequences, for example one or more fusion partner peptides (*e.g.*, GST, His₆, Trx, etc.) and the like.

As used herein, the terms "protein," "peptide," "oligopeptide" and "polypeptide" are considered synonymous (as is commonly recognized) and each term can be used interchangeably as the context requires to indicate a chain of two or more amino acids, preferably five or more amino acids, or more preferably ten

or more amino acids, coupled by (a) peptidyl linkage(s), unless otherwise defined in the specific contexts below. As is commonly recognized in the art, all polypeptide formulas or sequences herein are written from left to right and in the direction from amino terminus to carboxy terminus.

5 It will be recognized by those of ordinary skill in the art that some amino acid sequences of the polypeptides of the invention can be varied without significant effect on the structure or function of the polypeptides. If such differences in sequence are contemplated, it should be remembered that there will be critical areas on the protein which determine structure and activity. In general, it is
10 possible to replace residues which form the tertiary structure, provided that residues performing a similar function are used. In other instances, the type of residue may be completely unimportant if the alteration occurs at a non-critical region of the polypeptide.

Thus, the invention further includes variants of the polypeptides of the
15 invention, including allelic variants, which show substantial structural homology to the polypeptides described herein, or which include specific regions of these polypeptides such as the portions discussed below. Such mutants may include deletions, insertions, inversions, repeats, and type substitutions (for example, substituting one hydrophilic residue for another, but not strongly hydrophilic for
20 strongly hydrophobic as a rule). Small changes or such "neutral" or "conservative" amino acid substitutions will generally have little effect on activity.

Typical conservative substitutions are the replacements, one for another, among the aliphatic amino acids Ala, Val, Leu and Ile; interchange of the hydroxylated residues Ser and Thr; exchange of the acidic residues Asp and Glu;
25 substitution between the amidated residues Asn and Gln; exchange of the basic residues Lys and Arg; and replacements among the aromatic residues Phe and Tyr.

Thus, the fragment, derivative or analog of the polypeptides of the invention, such as those comprising peptides encoded by the recombination site nucleotide sequences described herein, may be (i) one in which one or more of the amino acid
30 residues are substituted with a conservative or non-conservative amino acid residue (preferably a conservative amino acid residue), and such substituted amino acid residue may be encoded by the genetic code or may be an amino acid (*e.g.*,

desmosine, citrulline, ornithine, etc.) that is not encoded by the genetic code; (ii) one in which one or more of the amino acid residues includes a substituent group (e.g., a phosphate, hydroxyl, sulfate or other group) in addition to the normal "R" group of the amino acid; (iii) one in which the mature polypeptide is fused with another compound, such as a compound to increase the half-life of the polypeptide (for example, polyethylene glycol), or (iv) one in which additional amino acids are fused to the mature polypeptide, such as an immunoglobulin Fc region peptide, a leader or secretory sequence, a sequence which is employed for purification of the mature polypeptide (such as GST) or a proprotein sequence. Such fragments, derivatives and analogs are intended to be encompassed by the present invention, and are within the scope of those skilled in the art from the teachings herein and the state of the art at the time of invention.

The polypeptides of the present invention are preferably provided in an isolated form, and preferably are substantially purified. Recombinantly produced versions of the polypeptides of the invention can be substantially purified by the one-step method described in Smith and Johnson, *Gene* 67:31-40 (1988). As used herein, the term "substantially purified" means a preparation of an individual polypeptide of the invention wherein at least 50%, preferably at least 60%, 70%, or 75% and more preferably at least 80%, 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% (by mass) of contaminating proteins (*i.e.*, those that are not the individual polypeptides described herein or fragments, variants, mutants or derivatives thereof) have been removed from the preparation.

The polypeptides of the present invention include those which are at least about 50% identical, at least 60% identical, at least 65% identical, more preferably at least about 70%, at least about 75%, at least about 80%, at least about 85%, at least about 90%, at least about 95%, at least about 96%, at least about 97%, at least about 98% or at least about 99% identical, to the polypeptides described herein. For example, preferred *attB1*-containing polypeptides of the invention include those that are at least about 50% identical, at least 60% identical, at least 65% identical, more preferably at least about 70%, at least about 75%, at least about 80%, at least about 85%, at least about 90%, at least about 95%, at least about 96%, at least about 97%, at least about 98% or at least about 99% identical,

to the polypeptide(s) encoded by the three reading frames of a polynucleotide comprising a nucleotide sequence of *attB1* having a nucleic acid sequence as set forth in Figure 9 (or a nucleic acid sequence complementary thereto), to a polypeptide encoded by a polynucleotide contained in the deposited cDNA clones described herein, or to a polypeptide encoded by a polynucleotide hybridizing under stringent conditions to a polynucleotide comprising a nucleotide sequence of *attB1* having a nucleic acid sequence as set forth in Figure 9 (or a nucleic acid sequence complementary thereto). Analogous polypeptides may be prepared that are at least about 65% identical, more preferably at least about 70%, at least about 75%, at least about 80%, at least about 85%, at least about 90%, at least about 95%, at least about 96%, at least about 97%, at least about 98% or at least about 99% identical, to the *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* and *attR2* polypeptides of the invention as depicted in Figure 9. The present polypeptides also include portions or fragments of the above-described polypeptides with at least 5, 10, 15, 20, or 25 amino acids.

By a polypeptide having an amino acid sequence at least, for example, 65% "identical" to a reference amino acid sequence of a given polypeptide of the invention is intended that the amino acid sequence of the polypeptide is identical to the reference sequence except that the polypeptide sequence may include up to 35 amino acid alterations per each 100 amino acids of the reference amino acid sequence of a given polypeptide of the invention. In other words, to obtain a polypeptide having an amino acid sequence at least 65% identical to a reference amino acid sequence, up to 35% of the amino acid residues in the reference sequence may be deleted or substituted with another amino acid, or a number of amino acids up to 35% of the total amino acid residues in the reference sequence may be inserted into the reference sequence. These alterations of the reference sequence may occur at the amino (N-) or carboxy (C-) terminal positions of the reference amino acid sequence or anywhere between those terminal positions, interspersed either individually among residues in the reference sequence or in one or more contiguous groups within the reference sequence. As a practical matter, whether a given amino acid sequence is, for example, at least 65% identical to the amino acid sequence of a given polypeptide of the invention can be determined

conventionally using known computer programs such as those described above for nucleic acid sequence identity determinations, or more preferably using the CLUSTAL W program (Thompson, J.D., *et al.*, *Nucleic Acids Res.* 22:4673-4680 (1994)).

5 The polypeptides of the present invention can be used as molecular weight markers on SDS-PAGE gels or on molecular sieve gel filtration columns using methods well known to those of skill in the art. In addition, as described in detail below, the polypeptides of the present invention can be used to raise polyclonal and monoclonal antibodies which are useful in a variety of assays for detecting
10 protein expression, localization, detection of interactions with other molecules, or for the isolation of a polypeptide (including a fusion polypeptide) of the invention.

 In another aspect, the present invention provides a peptide or polypeptide comprising an epitope-bearing portion of a polypeptide of the invention, which may be used to raise antibodies, particularly monoclonal antibodies, that bind
15 specifically to a one or more of the polypeptides of the invention. The epitope of this polypeptide portion is an immunogenic or antigenic epitope of a polypeptide of the invention. An "immunogenic epitope" is defined as a part of a protein that elicits an antibody response when the whole protein is the immunogen. These immunogenic epitopes are believed to be confined to a few loci on the molecule.
20 On the other hand, a region of a protein molecule to which an antibody can bind is defined as an "antigenic epitope." The number of immunogenic epitopes of a protein generally is less than the number of antigenic epitopes (*see, e.g.*, Geysen *et al.*, *Proc. Natl. Acad. Sci. USA* 81:3998- 4002 (1983)).

 As to the selection of peptides or polypeptides bearing an antigenic epitope
25 (*i.e.*, that contain a region of a protein molecule to which an antibody can bind), it is well-known in the art that relatively short synthetic peptides that mimic part of a protein sequence are routinely capable of eliciting an antiserum that reacts with the partially mimicked protein (*see, e.g.*, Sutcliffe, J.G., *et al.*, *Science* 219:660-666 (1983)). Peptides capable of eliciting protein-reactive sera are
30 frequently represented in the primary sequence of a protein, can be characterized by a set of simple chemical rules, and are not confined to the immunodominant regions of intact proteins (*i.e.*, immunogenic epitopes) or to the amino or carboxy

termini. Peptides that are extremely hydrophobic and those of six or fewer residues generally are ineffective at inducing antibodies that bind to the mimicked protein; longer peptides, especially those containing proline residues, usually are effective (Sutcliffe, J.G., *et al.*, *Science* 219:660-666 (1983)).

5 Epitope-bearing peptides and polypeptides of the invention designed according to the above guidelines preferably contain a sequence of at least five, more preferably at least seven or more amino acids contained within the amino acid sequence of a polypeptide of the invention. However, peptides or polypeptides comprising a larger portion of an amino acid sequence of a polypeptide of the invention, containing about 30 to about 50 amino acids, or any length up to and including the entire amino acid sequence of a given polypeptide of the invention, also are considered epitope-bearing peptides or polypeptides of the invention and also are useful for inducing antibodies that react with the mimicked protein. Preferably, the amino acid sequence of the epitope-bearing peptide is selected to provide substantial solubility in aqueous solvents (*i.e.*, the sequence includes relatively hydrophilic residues and highly hydrophobic sequences are preferably avoided); sequences containing proline residues are particularly preferred.

15 Non-limiting examples of epitope-bearing polypeptides or peptides that can be used to generate antibodies specific for the polypeptides of the invention include certain epitope-bearing regions of the polypeptides comprising amino acid sequences encoded by polynucleotides comprising one or more of the recombination site-encoding nucleic acid molecules of the invention, including those encoding *attB1*, *attB2*, *attP1*, *attP2*, *attL1*, *attL2*, *attR1* and *attR2* having the nucleotide sequences set forth in Figure 9 (or a nucleotide sequence complementary thereto); the complete amino acid sequences encoded by the three reading frames of the polynucleotides contained in the deposited clones described herein; and the amino acid sequences encoded by all reading frames of polynucleotides which hybridize under stringent hybridization conditions to polynucleotides having the nucleotide sequences encoding the recombination site sequences (or portions thereof) of the invention as set forth in Figure 9 (or a nucleic acid sequence complementary thereto). Other epitope-bearing polypeptides or peptides that may be used to generate antibodies specific for the polypeptides

of the invention will be apparent to one of ordinary skill in the art based on the primary amino acid sequences of the polypeptides of the invention described herein, via the construction of Kyte-Doolittle hydrophilicity and Jameson-Wolf antigenic index plots of the polypeptides of the invention using, for example, PROTEAN computer software (DNASTAR, Inc.; Madison, Wisconsin).

The epitope-bearing peptides and polypeptides of the invention may be produced by any conventional means for making peptides or polypeptides including recombinant means using nucleic acid molecules of the invention. For instance, a short epitope-bearing amino acid sequence may be fused to a larger polypeptide which acts as a carrier during recombinant production and purification, as well as during immunization to produce anti-peptide antibodies. Epitope-bearing peptides also may be synthesized using known methods of chemical synthesis (*see, e.g.*, U.S. Patent No. 4,631,211 and Houghten, R. A., *Proc. Natl. Acad. Sci. USA* 82:5131-5135 (1985), both of which are incorporated by reference herein in their entireties).

As one of skill in the art will appreciate, the polypeptides of the present invention and epitope-bearing fragments thereof may be immobilized onto a solid support, by techniques that are well-known and routine in the art. By "solid support" is intended any solid support to which a peptide can be immobilized. Such solid supports include, but are not limited to nitrocellulose, diazocellulose, glass, polystyrene, polyvinylchloride, polypropylene, polyethylene, dextran, Sepharose, agar, starch, nylon, beads and microtitre plates. Linkage of the peptide of the invention to a solid support can be accomplished by attaching one or both ends of the peptide to the support. Attachment may also be made at one or more internal sites in the peptide. Multiple attachments (both internal and at the ends of the peptide) may also be used according to the invention. Attachment can be via an amino acid linkage group such as a primary amino group, a carboxyl group, or a sulfhydryl (SH) group or by chemical linkage groups such as with cyanogen bromide (CNBr) linkage through a spacer. For non-covalent attachments to the support, addition of an affinity tag sequence to the peptide can be used such as GST (Smith, D.B., and Johnson, K.S., *Gene* 67:31 (1988)), polyhistidines (Hochuli, E., *et al.*, *J. Chromatog.* 411:77 (1987)), or biotin. Such affinity tags

may be used for the reversible attachment of the peptide to the support. Such immobilized polypeptides or fragments may be useful, for example, in isolating antibodies directed against one or more of the polypeptides of the invention, or other proteins or peptides that recognize other proteins or peptides that bind to one or more of the polypeptides of the invention, as described below.

As one of skill in the art will also appreciate, the polypeptides of the present invention and the epitope-bearing fragments thereof described herein can be combined with one or more fusion partner proteins or peptides, or portions thereof, including but not limited to GST, His₆, Trx, and portions of the constant domain of immunoglobulins (Ig), resulting in chimeric or fusion polypeptides. These fusion polypeptides facilitate purification of the polypeptides of the invention (EP 0 394 827; Traunecker *et al.*, *Nature* 331:84-86 (1988)) for use in analytical or diagnostic (including high-throughput) format.

Antibodies

In another aspect, the invention relates to antibodies that recognize and bind to the polypeptides (or epitope-bearing fragments thereof) or nucleic acid molecules (or portions thereof) of the invention. In a related aspect, the invention relates to antibodies that recognize and bind to one or more polypeptides encoded by all reading frames of one or more recombination site nucleic acid sequences or portions thereof, or to one or more nucleic acid molecules comprising one or more recombination site nucleic acid sequences or portions thereof, including but not limited to *att* sites (including *attB*1, *attB*2, *attP*1, *attP*2, *attL*1, *attL*2, *attR*1, *attR*2 and the like), *lox* sites (*e.g.*, *loxP*, *loxP*511, and the like), FRT, and the like, or mutants, fragments, variants and derivatives thereof. See generally U.S. Patent No. 5,888,732, which is incorporated herein by reference in its entirety. The antibodies of the present invention may be polyclonal or monoclonal, and may be prepared by any of a variety of methods and in a variety of species according to methods that are well-known in the art. See, for instance, U.S. Patent No. 5,587,287; Sutcliffe, J.G., *et al.*, *Science* 219:660-666 (1983); Wilson *et al.*, *Cell* 37: 767 (1984); and Bittle, F.J., *et al.*, *J. Gen. Virol.* 66:2347-2354 (1985). Antibodies specific for any of the polypeptides or nucleic acid molecules described

herein, such as antibodies specifically binding to one or more of the polypeptides encoded by the recombination site nucleotide sequences, or one or more nucleic acid molecules, described herein or contained in the deposited clones, antibodies against fusion polypeptides (*e.g.*, binding to fusion polypeptides between one or more of the fusion partner proteins and one or more of the recombination site polypeptides of the invention, as described herein), and the like, can be raised against the intact polypeptides or polynucleotides of the invention or one or more antigenic polypeptide fragments thereof.

As used herein, the term "antibody" (Ab) may be used interchangeably with the terms "polyclonal antibody" or "monoclonal antibody" (mAb), except in specific contexts as described below. These terms, as used herein, are meant to include intact molecules as well as antibody fragments (such as, for example, Fab and F(ab')₂ fragments) which are capable of specifically binding to a polypeptide or nucleic acid molecule of the invention or a portion thereof. It will therefore be appreciated that, in addition to the intact antibodies of the invention, Fab, F(ab')₂ and other fragments of the antibodies described herein, and other peptides and peptide fragments that bind one or more polypeptides or polynucleotides of the invention, are also encompassed within the scope of the invention. Such antibody fragments are typically produced by proteolytic cleavage of intact antibodies, using enzymes such as papain (to produce Fab fragments) or pepsin (to produce F(ab')₂ fragments). Antibody fragments, and peptides or peptide fragments, may also be produced through the application of recombinant DNA technology or through synthetic chemistry.

Epitope-bearing peptides and polypeptides, and nucleic acid molecules or portions thereof, of the invention may be used to induce antibodies according to methods well known in the art, as generally described herein (*see, e.g.*, Sutcliffe, *et al.*, *supra*; Wilson, *et al.*, *supra*; and Bittle, F. J., *et al.*, *J. Gen. Virol.* 66:2347-2354 (1985)).

Polyclonal antibodies according to this aspect of the invention may be made by immunizing an animal with one or more of the polypeptides or nucleic acid molecules of the invention described herein or portions thereof according to standard techniques (*see, e.g.*, Harlow, E., and Lane, D., *Antibodies: A*

Laboratory Manual, Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press (1988); Kaufman, P.B., *et al.*, In: *Handbook of Molecular and Cellular Methods in Biology and Medicine*, Boca Raton, Florida: CRC Press, pp. 468-469 (1995)). For producing antibodies that recognize and bind to the polypeptides or nucleic acid molecules of the invention or portions thereof, animals may be immunized with free peptide or free nucleic acid molecules; however, antibody titer may be boosted by coupling of the peptide to a macromolecular carrier, such as albumin, KLH, or tetanus toxoid (particularly for producing antibodies against the nucleic acid molecules of the invention or portions thereof; *see* Harlow and Lane, *supra*, at page 154), or to a solid phase carrier such as a latex or glass microbead. For instance, peptides containing cysteine may be coupled to carrier using a linker such as m-maleimidobenzoyl-N-hydroxysuccinimide ester (MBS), while other peptides may be coupled to carrier using a more general linking agent such as glutaraldehyde. Animals such as rabbits, rats and mice may be immunized with either free (if the polypeptide immunogen is larger than about 25 amino acids in length) or carrier-coupled peptides or nucleic acid molecules, for instance, by intraperitoneal and/or intradermal injection of emulsions containing about 100 µg peptide, polynucleotide, or carrier protein, and Freund's adjuvant. Several booster injections may be needed, for instance, at intervals of about two weeks, to provide a useful titer of antibody which can be detected, for example, by ELISA assay using free peptide or nucleic acid molecule adsorbed to a solid surface. In another approach, cells expressing one or more of the polypeptides or polynucleotides of the invention or an antigenic fragment thereof can be administered to an animal in order to induce the production of sera containing polyclonal antibodies, according to routine immunological methods. In yet another method, a preparation of one or more of the polypeptides or polynucleotides of the invention is prepared and purified as described herein, to render it substantially free of natural contaminants. Such a preparation may then be introduced into an animal in order to produce polyclonal antisera of greater specific activity. The titer of antibodies in serum from an immunized animal, regardless of the method of immunization used, may be increased by selection of anti-peptide or anti-polynucleotide antibodies, for

instance, by adsorption to the peptide or polynucleotide on a solid support and elution of the selected antibodies according to methods well known in the art.

In an alternative method, the antibodies of the present invention are monoclonal antibodies (or fragments thereof which bind to one or more of the polypeptides of the invention). Such monoclonal antibodies can be prepared using hybridoma technology (Kohler *et al.*, *Nature* 256:495 (1975); Köhler *et al.*, *Eur. J. Immunol.* 6:511 (1976); Köhler *et al.*, *Eur. J. Immunol.* 6:292 (1976); Hammerling *et al.*, In: *Monoclonal Antibodies and T-Cell Hybridomas*, Elsevier, N.Y., pp. 563-681 (1981)). In general, such procedures involve immunizing an animal (preferably a mouse) with a polypeptide or polynucleotide of the invention (or a fragment thereof), or with a cell expressing a polypeptide or polynucleotide of the invention (or a fragment thereof). The splenocytes of such mice are extracted and fused with a suitable myeloma cell line. Any suitable myeloma cell line may be employed in accordance with the present invention; however, it is preferable to employ the parent myeloma cell line (SP₂O), available from the American Type Culture Collection, Rockville, Maryland. After fusion, the resulting hybridoma cells are selectively maintained in HAT medium, and then cloned by limiting dilution as described by Wands *et al.* (*Gastroenterol.* 80:225-232 (1981)). The hybridoma cells obtained through such a selection are then assayed to identify clones which secrete antibodies capable of binding one or more of the polypeptides or nucleic acid molecules of the invention, or fragments thereof. Hence, the present invention also provides hybridoma cells and cell lines producing monoclonal antibodies of the invention, particularly that recognize and bind to one or more of the polypeptides or nucleic acid molecules of the invention.

Alternatively, additional antibodies capable of binding to one or more of the polypeptides of the invention, or fragments thereof, may be produced in a two-step procedure through the use of anti-idiotypic antibodies. Such a method makes use of the fact that antibodies are themselves antigens, and that, therefore, it is possible to obtain an antibody which binds to a second antibody. In accordance with this method, antibodies specific for one or more of the polypeptides or polynucleotides of the invention, prepared as described above, are used to immunize an animal, preferably a mouse. The splenocytes of such an

animal are then used to produce hybridoma cells, and the hybridoma cells are screened to identify clones which produce an antibody whose ability to bind to an antibody specific for one or more of the polypeptides or polynucleotides of the invention can be blocked by polypeptides of the invention themselves. Such antibodies comprise anti-idiotypic antibodies to the antibodies recognizing one or more of the polypeptides or polynucleotides of the invention, and can be used to immunize an animal to induce formation of further antibodies specific for one or more of the polypeptides or polynucleotides of the invention.

For use, the antibodies of the invention may optionally be detectably labeled by covalent or non-covalent attachment of one or more labels, including but not limited to chromogenic, enzymatic, radioisotopic, isotopic, fluorescent, toxic, chemiluminescent, or nuclear magnetic resonance contrast agents or other labels.

Examples of suitable enzyme labels include malate dehydrogenase, staphylococcal nuclease, delta-5-steroid isomerase, yeast-alcohol dehydrogenase, alpha-glycerol phosphate dehydrogenase, triose phosphate isomerase, peroxidase, alkaline phosphatase, asparaginase, glucose oxidase, beta-galactosidase, ribonuclease, urease, catalase, glucose-6-phosphate dehydrogenase, glucoamylase, and acetylcholine esterase.

Examples of suitable radioisotopic labels include ^3H , ^{111}In , ^{125}I , ^{131}I , ^{32}P , ^{35}S , ^{14}C , ^{51}Cr , ^{57}Co , ^{58}Co , ^{59}Fe , ^{75}Se , ^{152}Eu , ^{90}Y , ^{67}Cu , ^{217}Bi , ^{211}At , ^{212}Pb , ^{47}Sc , ^{109}Pd , etc. ^{111}In is a preferred isotope where in vivo imaging is used since it avoids the problem of dehalogenation of the ^{125}I or ^{131}I -labeled monoclonal antibody by the liver. In addition, this radionuclide has a more favorable gamma emission energy for imaging (Perkins *et al.*, *Eur. J. Nucl. Med.* 10:296-301 (1985); Carasquillo *et al.*, *J. Nucl. Med.* 28:281-287 (1987)). For example, ^{111}In coupled to monoclonal antibodies with 1-(P-isothiocyanatobenzyl)-DPTA has shown little uptake in non-tumorous tissues, particularly the liver, and therefore enhances specificity of tumor localization (Esteban *et al.*, *J. Nucl. Med.* 28:861-870 (1987)).

Examples of suitable non-radioactive isotopic labels include ^{157}Gd , ^{55}Mn , ^{162}Dy , ^{52}Tr , and ^{56}Fe .

Examples of suitable fluorescent labels include an ^{152}Eu label, a fluorescein label, an isothiocyanate label, a rhodamine label, a phycoerythrin label, a

phycocyanin label, an allophycocyanin label, an o-phthaldehyde label, a green fluorescent protein (GFP) label, and a fluorescamine label.

Examples of suitable toxin labels include diphtheria toxin, ricin, and cholera toxin.

5 Examples of chemiluminescent labels include a luminal label, an isoluminal label, an aromatic acridinium ester label, an imidazole label, an acridinium salt label, an oxalate ester label, a luciferin label, a luciferase label, and an aequorin label.

10 Examples of nuclear magnetic resonance contrasting agents include heavy metal nuclei such as Gd, Mn, and iron.

15 Typical techniques for binding the above-described labels to the antibodies of the invention are provided by Kennedy *et al.*, *Clin. Chim. Acta* 70:1-31 (1976), and Schurs *et al.*, *Clin. Chim. Acta* 81:1-40 (1977). Coupling techniques mentioned in the latter are the glutaraldehyde method, the periodate method, the dimaleimide method, the m-maleimidobenzyl-N-hydroxy-succinimide ester method, all of which methods are incorporated by reference herein.

20 It will be appreciated by one of ordinary skill that the antibodies of the present invention may alternatively be coupled to a solid support, to facilitate, for example, chromatographic and other immunological procedures using such solid phase-immobilized antibodies. Included among such procedures are the use of the antibodies of the invention to isolate or purify polypeptides comprising one or more epitopes encoded by the nucleic acid molecules of the invention (which may be fusion polypeptides or other polypeptides of the invention described herein), or to isolate or purify polynucleotides comprising one or more recombination site
25 sequences of the invention or portions thereof. Methods for isolation and purification of polypeptides (and, by analogy, polynucleotides) by affinity chromatography, for example using the antibodies of the invention coupled to a solid phase support, are well-known in the art and will be familiar to one of ordinary skill. The antibodies of the invention may also be used in other
30 applications, for example to cross-link or couple two or more proteins, polypeptides, polynucleotides, or portions thereof into a structural and/or functional complex. In one such use, an antibody of the invention may have two

or more distinct epitope-binding regions that may bind, for example, a first polypeptide (which may be a polypeptide of the invention) at one epitope-binding region on the antibody and a second polypeptide (which may be a polypeptide of the invention) at a second epitope-binding region on the antibody, thereby bringing the first and second polypeptides into close proximity to each other such that the first and second polypeptides are able to interact structurally and/or functionally (as, for example, linking an enzyme and its substrate to carry out enzymatic catalysis, or linking an effector molecule and its receptor to carry out or induce a specific binding of the effector molecule to the receptor or a response to the effector molecule mediated by the receptor). Additional applications for the antibodies of the invention include, for example, the preparation of large-scale arrays of the antibodies, polypeptides, or nucleic acid molecules of the invention, or portions thereof, on a solid support, for example to facilitate high-throughput screening of protein or RNA expression by host cells containing nucleic acid molecules of the invention (known in the art as "chip array" protocols; *see, e.g.*, U.S. Patent Nos. 5,856,101, 5,837,832, 5,770,456, 5,744,305, 5,631,734, and 5,593,839, which are directed to production and use of chip arrays of polypeptides (including antibodies) and polynucleotides, and the disclosures of which are incorporated herein by reference in their entireties). By "solid support" is intended any solid support to which an antibody can be immobilized. Such solid supports include, but are not limited to nitrocellulose, diazocellulose, glass, polystyrene, polyvinylchloride, polycarbonate, polypropylene, polyethylene, dextran, Sepharose, agar, starch, nylon, beads and microtitre plates. Preferred are beads made of glass, latex or a magnetic material. Linkage of an antibody of the invention to a solid support can be accomplished by attaching one or both ends of the antibody to the support. Attachment may also be made at one or more internal sites in the antibody. Multiple attachments (both internal and at the ends of the antibody) may also be used according to the invention. Attachment can be via an amino acid linkage group such as a primary amino group, a carboxyl group, or a sulfhydryl (SH) group or by chemical linkage groups such as with cyanogen bromide (CNBr) linkage through a spacer. For non-covalent attachments, addition of an affinity tag sequence to the peptide can be used such as GST

(Smith, D.B., and Johnson, K.S., *Gene* 67:31 (1988)), polyhistidines (Hochuli, E., *et al.*, *J. Chromatog.* 411:77 (1987)), or biotin. Alternatively, attachment can be accomplished using a ligand which binds the Fc region of the antibodies of the invention, *e.g.*, protein A or protein G. Such affinity tags may be used for the reversible attachment of the antibodies to the support. Peptides may also be recognized via specific ligand-receptor interactions or using phage display methodologies that will be familiar to the skilled artisan, for their ability to bind polypeptides of the invention or fragments thereof.

Kits

In another aspect, the invention provides kits which may be used in producing the nucleic acid molecules, polypeptides, vectors, host cells, and antibodies, and in the recombinational cloning methods, of the invention. Kits according to this aspect of the invention may comprise one or more containers, which may contain one or more of the nucleic acid molecules, primers, polypeptides, vectors, host cells, or antibodies of the invention. In particular, a kit of the invention may comprise one or more components (or combinations thereof) selected from the group consisting of one or more recombination proteins (*e.g.*, Int) or auxiliary factors (*e.g.* IHF and/or Xis) or combinations thereof, one or more compositions comprising one or more recombination proteins or auxiliary factors or combinations thereof (for example, GATEWAY™ LR Clonase™ Enzyme Mix or GATEWAY™ BP Clonase™ Enzyme Mix) one or more Destination Vector molecules (including those described herein), one or more Entry Clone or Entry Vector molecules (including those described herein), one or more primer nucleic acid molecules (particularly those described herein), one or more host cells (*e.g.* competent cells, such as *E. coli* cells, yeast cells, animal cells (including mammalian cells, insect cells, nematode cells, avian cells, fish cells, etc.), plant cells, and most particularly *E. coli* DB3, DB3.1 (preferably *E. coli* LIBRARY EFFICIENCY® DB3.1™ Competent Cells; Life Technologies, Inc., Rockville, MD), DB4 and DB5; *see* U.S. Provisional Application No. 60/122,392, filed on March 2, 1999, and the corresponding U.S. Utility Application No. _____ of Hartley *et al.*, entitled "Cells Resistant to Toxic Genes and Uses Thereof," filed

on even day herewith, the disclosures of which are incorporated by reference herein in its entirety), and the like. In related aspects, the kits of the invention may comprise one or more nucleic acid molecules encoding one or more recombination sites or portions thereof, such as one or more nucleic acid molecules comprising a nucleotide sequence encoding the one or more recombination sites (or portions thereof) of the invention, and particularly one or more of the nucleic acid molecules contained in the deposited clones described herein. Kits according to this aspect of the invention may also comprise one or more isolated nucleic acid molecules of the invention, one or more vectors of the invention, one or more primer nucleic acid molecules of the invention, and/or one or more antibodies of the invention. The kits of the invention may further comprise one or more additional containers containing one or more additional components useful in combination with the nucleic acid molecules, polypeptides, vectors, host cells, or antibodies of the invention, such as one or more buffers, one or more detergents, one or more polypeptides having nucleic acid polymerase activity, one or more polypeptides having reverse transcriptase activity, one or more transfection reagents, one or more nucleotides, and the like. Such kits may be used in any process advantageously using the nucleic acid molecules, primers, vectors, host cells, polypeptides, antibodies and other compositions of the invention, for example in methods of synthesizing nucleic acid molecules (*e.g.*, via amplification such as via PCR), in methods of cloning nucleic acid molecules (preferably via recombinational cloning as described herein), and the like.

Optimization of Recombinational Cloning System

The usefulness of a particular nucleic acid molecule, or vector comprising a nucleic acid molecule, of the invention in methods of recombinational cloning may be determined by any one of a number of assay methods. For example, Entry and Destination vectors of the present invention may be assessed for their ability to function (*i.e.*, to mediate the transfer of a nucleic acid molecule, DNA segment, gene, cDNA molecule or library from a cloning vector to an Expression Vector) by carrying out a recombinational cloning reaction as described in more detail in the Examples below and as described in U.S. Application Nos. 08/663,002, filed

June 7, 1996 (now U.S. Patent No. 5,888,732), 09/005,476, filed January 12, 1998, 09/177,387, filed October 23, 1998, and 60/108,324, filed November 13, 1998, the disclosures of which are incorporated by reference herein in their entireties. Alternatively, the functionality of Entry and Destination Vectors prepared according to the invention may be assessed by examining the ability of these vectors to recombine and create cointegrate molecules, or to transfer a nucleic acid molecule of interest, using an assay such as that described in detail below in Example 19. Analogously, the formulation of compositions comprising one or more recombination proteins or combinations thereof, for example GATEWAY™ LR Clonase™ Enzyme Mix and GATEWAY™ BP Clonase™ Enzyme Mix, may be optimized using assays such as those described below in Example 18.

Uses

There are a number of applications for the compositions, methods and kits of the present invention. These uses include, but are not limited to, changing vectors, targeting gene products to intracellular locations, cleaving fusion tags from desired proteins, operably linking nucleic acid molecules of interest to regulatory genetic sequences (*e.g.*, promoters, enhancers, and the like), constructing genes for fusion proteins, changing copy number, changing replicons, cloning into phages, and cloning, *e.g.*, PCR products, genomic DNAs, and cDNAs. In addition, the nucleic acid molecules, vectors, and host cells of the invention may be used in the production of polypeptides encoded by the nucleic acid molecules, in the production of antibodies directed against such polypeptides, in recombinational cloning of desired nucleic acid sequences, and in other applications that may be enhanced or facilitated by the use of the nucleic acid molecules, vectors, and host cells of the invention.

In particular, the nucleic acid molecules, vectors, host cells, polypeptides, antibodies, and kits of the invention may be used in methods of transferring one or more desired nucleic acid molecules or DNA segments, for example one or more genes, cDNA molecules or cDNA libraries, into a cloning or Expression Vector for use in transforming additional host cells for use in cloning or

amplification of, or expression of the polypeptide encoded by, the desired nucleic acid molecule or DNA segment. Such recombinational cloning methods which may advantageously use the nucleic acid molecules, vectors, and host cells of the invention, are described in detail in the Examples below, and in commonly owned
5 U.S. Application Nos. 08/486,139, filed June 7, 1995, 08/663,002, filed June 7, 1996 (now U.S. Patent No. 5,888,732), 09/005,476, filed January 12, 1998, 09/177,387, filed October 23, 1998, and 60/108,324, filed November 13, 1998, the disclosures of all of which are incorporated by reference herein in their entireties.

10 It will be understood by one of ordinary skill in the relevant arts that other suitable modifications and adaptations to the methods and applications described herein are readily apparent from the description of the invention contained herein in view of information known to the ordinarily skilled artisan, and may be made
15 without departing from the scope of the invention or any embodiment thereof. Having now described the present invention in detail, the same will be more clearly understood by reference to the following examples, which are included herewith for purposes of illustration only and are not intended to be limiting of the invention.

20 *Examples*

Example 1: Recombination Reactions of Bacteriophage λ

25 The *E. coli* bacteriophage λ can grow as a lytic phage, in which case the host cell is lysed, with the release of progeny virus. Alternatively, lambda can integrate into the genome of its host by a process called lysogenization (see Figure 60). In this lysogenic state, the phage genome can be transmitted to daughter cells for many generations, until conditions arise that trigger its excision from the genome.
30 At this point, the virus enters the lytic part of its life cycle. The control of the switch between the lytic and lysogenic pathways is one of the best understood processes in molecular biology (M. Ptashne, *A Genetic Switch*, Cell Press, 1992).

The integrative and excisive recombination reactions of λ , performed *in vitro*, are the basis of Recombinational Cloning System of the present invention. They can be represented schematically as follows:



10 The four att sites contain binding sites for the proteins that mediate the reactions. The wild type attP, attB, attL, and attR sites contain about 243, 25, 100, and 168 base pairs, respectively. The attB x attP reaction (hereinafter referred to as a "BP Reaction," or alternatively and equivalently as an "Entry Reaction" or a "Gateward Reaction") is mediated by the proteins Int and IHF. The attL x attR reaction (hereinafter referred to as an "LR Reaction," or alternatively and equivalently as a "Destination Reaction") is mediated by the proteins Int, IHF, and Xis. Int (integrase) and Xis (excisionase) are encoded by the λ genome, while IHF (integration host factor) is an *E. coli* protein. For a general review of lambda recombination, see: A. Landy, *Ann. Rev. Biochem.* 58: 913-949 (1989).

20 ***Example 2: Recombination Reactions of the Recombinational Cloning System***

The LR Reaction -- the exchange of a DNA segment from an Entry Clone to a Destination Vector -- is the *in vitro* version of the λ excision reaction:



30 There is a practical imperative for this configuration: after an LR Reaction in one configuration of the present method, an att site usually separates a functional motif (such as a promoter or a fusion tag) from a nucleic acid molecule of interest in an Expression Clone, and the 25 bp attB site is much smaller than the attP, attL, and attR sites.

Note that the recombination reaction is conservative, i.e., there is no net synthesis or loss of base pairs. The DNA segments that flank the recombination

sites are merely switched. The wild type λ recombination sites are modified for purposes of the GATEWAY™ Cloning System, as follows:

To create certain preferred Destination Vectors, a part (43 bp) of attR was removed, to make the excisive reaction irreversible and more efficient (W. Bushman et al., *Science* 230: 906, 1985). The attR sites in preferred Destination Vectors of the invention are 125 bp in length. Mutations were made to the core regions of the att sites, for two reasons: (1) to eliminate stop codons, and (2) to ensure specificity of the recombination reactions (i.e., attR1 reacts only with attL1, attR2 reacts only with attL2, etc.).

Other mutations were introduced into the short (5 bp) regions flanking the 15 bp core regions of the attB sites to minimize secondary structure formation in single-stranded forms of attB plasmids, e.g., in phagemid ssDNA or in mRNA. Sequences of attB1 and attB2 to the left and right of a nucleic acid molecule of interest after it has been cloned into a Destination Vector are given in Figure 6.

Figure 61 illustrates how an Entry Clone and a Destination Vector recombine in the LR Reaction to form a co-integrate, which resolves through a second reaction into two daughter molecules. The two daughter molecules have the same general structure regardless of which pair of sites, attL1 and attR1 or attL2 and attR2, react first to form the co-integrate. The segments change partners by these reactions, regardless of whether the parental molecules are both circular, one is circular and one is linear, or both are linear. In this example, selection for ampicillin resistance carried on the Destination Vector, which also carries the death gene *ccdB*, provides the means for selecting only for the desired attB product plasmid.

Example 3: Protein Expression in the Recombinational Cloning System

Proteins are expressed *in vivo* as a result of two processes, transcription (DNA into RNA), and translation (RNA into protein). For a review of protein expression in prokaryotes and eukaryotes, see Example 13 below. Many vectors (pUC, BlueScript, pGem) use interruption of a transcribed *lacZ* gene for blue-white screening. These plasmids, and many Expression Vectors, use the *lac* promoter to control expression of cloned genes. Transcription from the *lac*

promoter is turned on by adding the inducer IPTG. However, a low level of RNA is made in the absence of inducer, i.e., the lac promoter is never completely off. The result of this "leakiness" is that genes whose expression is harmful to *E. coli* may prove difficult or impossible to clone in vectors that contain the lac promoter, or they may be cloned only as inactive mutants.

In contrast to other gene expression systems, nucleic acid molecules cloned into an Entry Vector may be designed *not* to be expressed. The presence of the strong transcriptional terminator *rrnB* (Orosz, et al., *Eur. J. Biochem.* 201: 653, 1991) just upstream of the attL1 site keeps transcription from the vector promoters (drug resistance and replication origin) from reaching the cloned gene. However, if a toxic gene is cloned into a Destination Vector, the host may be sick, just as in other expression systems. But the reliability of subcloning by *in vitro* recombination makes it easier to recognize that this has happened -- and easier to try another expression option in accordance with the methods of the invention, if necessary.

Example 4: Choosing the Right Entry Vector

There are two kinds of choices that must be made in choosing the best Entry Vector, dictated by (1) the particular DNA segment that is to be cloned, and (2) what is to be accomplished with the cloned DNA segment. These factors are critical in the choice of Entry Vector used, because when the desired nucleic acid molecule of interest is moved from the Entry Vector to a Destination Vector, all the base pairs between the nucleic acid molecule of interest and the Int cutting sites in attL1 and attL2 (such as in Figure 6) move into the Destination Vector as well. For genomic DNAs that are not expressed as a result of moving into a Destination Vector, these decisions are not as critical.

For example, if an Entry Vector with certain translation start signals is used, those sequences will be translated into amino acids if an amino-terminal fusion to the desired nucleic acid molecule of interest is made. Whether the desired nucleic acid molecule of interest is to be expressed as fusion protein, native protein, or both, dictates whether translational start sequences must be included between the attB sites of the clone (native protein) or, alternatively, supplied by the Destination

Vector (fusion protein). In particular, Entry Clones that include translational start sequences may prove less suitable for making fusion proteins, as internal initiation of translation at these sites can decrease the yield of N-terminal fusion protein. These two types of expression afforded by the compositions and methods of the invention are illustrated in Figure 62.

No Entry Vector is likely to be optimal for all applications. The nucleic acid molecule of interest may be cloned into any of several optimal Entry Vectors.

As an example, consider pENTR7 (Figure 16) and pENTR11 (Figure 20), which are useful in a variety of applications, including (but not limited to):

- Cloning cDNAs from most of the commercially available libraries. The sites to the left and right of the *ccdB* death gene have been chosen so that directional cloning is possible if the DNA to be cloned does not have two or more of these restriction sites.

- Cloning of genes directionally: *SalI*, *BamHI*, *XmnI* (blunt), or *KpnI* on the left of *ccdB*; *NotI*, *XhoI*, *XbaI*, or *EcoRV* (blunt), on the right.

- Cloning of genes or gene fragments with a blunt amino end at the *XmnI* site. The *XmnI* site has four of the six most favored bases for eukaryotic expression (see Example 13, below), so that if the first three bases of the DNA to be cloned are ATG, the open reading frame (ORF) will be expressed in eukaryotic cells (e.g., mammalian cells, insect cells, yeast cells) when it is transcribed in the appropriate Destination Vector. In addition, in pENTR11, a Shine-Dalgarno sequence is situated 8 bp upstream, for initiating protein synthesis in a prokaryotic host cell (particularly a bacterial cell, such as *E. coli*) at an ATG.

- Cleaving off amino terminal fusions (e.g., His₆, GST, or thioredoxin) using the highly specific TEV (Tobacco Etch Virus) protease (available from Life Technologies, Inc.). If the nucleic acid molecule of interest is cloned at the

blunt *Xmn*I site, TEV cleavage will leave two amino acids on the amino end of the expressed protein.

•Selecting against uncut or singly cut Entry Vector molecules during cloning with restriction enzymes and ligase. If the *ccdB* gene is not removed with a double digest, it will kill any recipient *E. coli* cell that does not contain a mutation that makes the cell resistant to *ccdB* (see U.S. Provisional Application No. 60/122,392, filed on March 2, 1999, the disclosure of which is incorporated by reference herein in its entirety).

•Allowing production of amino fusions with ORFs in all cloning sites. There are no stop codons (in the attL1 reading frame) upstream of the *ccdB* gene.

In addition, pENTR11 is also useful in the following applications:

•Cloning cDNAs that have an *Nco*I site at the initiating ATG into the *Nco*I site. Similar to the *Xmn*I site, this site has four of the six most favored bases for eukaryotic expression. Also, a Shine-Dalgarno sequence is situated 8 bp upstream, for initiating protein synthesis in a prokaryotic host cell (particularly a bacterial cell, such as *E. coli*) at an ATG.

•Producing carboxy fusion proteins with ORFs positioned in phase with the reading frame convention for carboxy-terminal fusions (see Figure 20A).

Table 1 lists some non-limiting examples of Entry Vectors and their characteristics, and Figures 10-20 show their cloning sites. All of the Entry Vectors listed in Table 1 are available commercially from Life Technologies, Inc., Rockville, Maryland. Other Entry Vectors not specifically listed here, which comprise alternative or additional features may be made by one of ordinary skill using routine methods of molecular and cellular biology, in view of the disclosure contained herein.

Table 1 Examples of Entry Vectors

Designation	Mnemonic Name	Class of Entry Vector	Distinctive Cloning Sites	Amino Fusions	Native Protein in E.coli	Native Protein in Eukaryotic Cells	Protein Synthesis Features
pENTR-1A, 2B, 3C	Minimal blunt RF A, B, C	Alternative Reading Frame Vectors	Reading frame A, B, or C; blunt cut closest to attL1	Good	Poor	Good	Minimal amino acids between tag and protein; no SD
pENTR4	Minimal Nco	Restr. Enz. Cleavage Vectors	Nco I site (common in euk. cDNAs) closest to attL1	Good	Poor	Good	Good Kozac; no SD
pENTR5	Minimal Nde	Restr. Enz. Cleavage Vectors	NdeI site closest to attL1	Good	Poor	Poor at Nde I, Good at Xmn I	No SD; poor Kozac at Nde, good at Xmn
pENTR6	Minimal Sph	Restr. Enz. Cleavage Vectors	Sph I site closest to attL1	Good	Poor	Poor at Sph I, Good at Xmn I	No SD; poor Kozac at Sph, good at Xmn
pENTR7	TEV Blunt	TEV Cleavage Site Present	Xmn I (blunt) is first cloning site after TEV site	Good	Poor	Good at Xmn I site	TEV protease leaves Gly-Thr on amino end of protein; no SD
pENTR8	TEV Nco	TEV Cleavage Site Present	Nco I is first cloning site after TEV site	Good	Poor	Good	TEV protease leaves Gly-Thr on amino end of protein; no SD

pENTR9	TEV Nde	TEV Cleavage Site Present	Nde I is first cloning site after TEV site	Good	Poor	Poor	TEV protease leaves Gly-Thr on amino end of protein; no SD, poor Kozac
pENTR10	Nde with SD	Good SD for E.coli Expression	Strong SD; Nde I site, no TEV	Poor	Good	Poor	Strong SD, internal starts in amino fusions. Poor Kz. No TEV
pENTR11	2 X SD+Kozac	Good SD for E.coli Expression	Xmn I (blunt) and Nco I sites each preceded by SD and Kozac	Good	Good	Good	Strong SD/Koz Internal starts in amino fusions. No TEV

Entry vectors pENTR1A (Figures 10A and 10B), pENTR2B (Figures 11A and 11B), and pENTR3C (Figures 12A and 12B) are almost identical, except that the restriction sites are in different reading frames. Entry vectors pENTR4 (Figures 13A and 13B), pENTR5 (Figures 14A and 14B), and pENTR6 (Figures 15A and 15B) are essentially identical to pENTR1A, except that the blunt *DraI* site has been replaced with sites containing the ATG methionine codon: *NcoI* in pENTR4, *NdeI* in pENTR5, and *SphI* in pENTR6. Nucleic acid molecules that contain one of these sites at the initiating ATG can be conveniently cloned in these Entry vectors. The *NcoI* site in pENTR4 is especially useful for expression of nucleic acid molecules in eukaryotic cells, since it contains many of the bases that give efficient translation (*see* Example 13, below). (Nucleic acid molecules of interest cloned into the *NdeI* site of pENTR5 are not expected to be highly expressed in eukaryotic cells, because the cytosine at position -3 from the initiating ATG is rare in eukaryotic genes.)

Entry vectors pENTR7 (Figures 16A and 16B), pENTR8 (Figures 17A and 17B), and pENTR9 (Figures 18A and 18B) contain the recognition site for the TEV protease between the attL1 site and the cloning sites. Cleavage sites for *XmnI* (blunt), *NcoI*, and *NdeI*, respectively, are the most 5' sites in these Entry vectors. Amino fusions can be removed efficiently if nucleic acid molecules are cloned into these Entry vectors. TEV protease is highly active and highly specific.

Example 5: Controlling Reading Frame

One of the trickiest tasks in expression of cloned nucleic acid molecules is making sure the reading frame is correct. (Reading frame is important if fusions are being made between two ORFs, for example between a nucleic acid molecule of interest and a His6 or GST domain.) For purposes of the present invention, the following convention has been adopted: The reading frame of the DNA cloned into any Entry Vector must be in phase with that of the attB1 site shown in Figure 16A, pENTR7. Notice that the six As of the attL1 site are split into two lysine codons (aaa aaa). The Destination Vectors that make amino fusions were constructed such that they enter the attR1 site in this reading frame.

Destination Vectors for carboxy terminal fusions were also constructed, including those containing His₆ (pDEST23; Figure 43), GST (pDEST24; Figure 44), or thioredoxin (pDEST25; Figure 45) C-terminal fusion sequences.

Therefore, if a nucleic acid molecule of interest is cloned into an Entry Vector so that the aaa aaa reading frame within the attL1 site is in phase with the nucleic acid molecule's ORF, amino terminal fusions will automatically be correctly phased, for all the fusion tags. This is a significant improvement over the usual case, where each different vector can have different restriction sites and different reading frames.

See Example 15 for a practical example of how to choose the most appropriate combinations of Entry Vector and Destination Vector.

Materials

Unless otherwise indicated, the following materials were used in the remaining Examples included herein:

5X LR Reaction Buffer:

200-250 mM (preferably 250 mM) Tris-HCl, pH 7.5

250-350 mM (preferably 320 mM) NaCl

1.25-5 mM (preferably 4.75 mM) EDTA

12.5-35 mM (preferably 22-35 mM, and most preferably 35 mM)

Spermidine-HCl

1 mg/ml bovine serum albumin

GATEWAY™ LR Clonase™ Enzyme Mix:

per 4 µl of 1X LR Reaction Buffer:

150 ng carboxy-His6-tagged Int (see U.S. Appl. Nos. 60/108,324, filed November 13, 1998, and 09/438,358, filed November 12, 1999, both entirely incorporated by reference herein)

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25 ng carboxy-His6-tagged Xis (see U.S. Appl. Nos. 60/108,324, filed
November 13, 1998, and 09/438,358, filed November 12,
1999, both entirely incorporated by reference herein)

30 ng IHF

50% glycerol

5X BP Reaction Buffer:

125 mM Tris-HCl, pH 7.5

110 mM NaCl

25 mM EDTA

25 mM Spermidine-HCl

5 mg/ml bovine serum albumin

GATEWAY™ BP Clonase™ Enzyme Mix:

per 4 µl of 1X BP Reaction Buffer:

200 ng carboxy-His6-tagged Int (see U.S. Appl. Nos. 60/108,324, filed
November 13, 1998, and 09/438,358, filed November 12,
1999, both entirely incorporated by reference herein)

80 ng IHF

50% glycerol

10X Clonase Stop Solution:

50 mM Tris-HCl, pH 8.0

1 mM EDTA

2 mg/ml Proteinase K

Example 6: LR ("Destination") Reaction

To create a new Expression Clone containing the nucleic acid molecule of
interest (and which may be introduced into a host cell, ultimately for production
of the polypeptide encoded by the nucleic acid molecule), an Entry Clone or
Vector containing the nucleic acid molecule of interest, prepared as described

herein, is reacted with a Destination Vector. In the present example, a β -Gal gene flanked by attL sites is transferred from an Entry Clone to a Destination Vector.

Materials needed:

- 5 X LR Reaction buffer
- Destination Vector (preferably linearized), 75-150 ng/ μ l
- Entry Clone containing nucleic acid molecule of interest, 100-300 ng in $\leq 8 \mu$ l TE buffer
- Positive control Entry Clone (pENTR- β -Gal) DNA (See note, below)
- Positive control Destination Vector, pDEST1 (pTrc), 75 ng/ μ l
- GATEWAY™ LR Clonase™ Enzyme Mix (stored at - 80° C)
- 10X Clonase Stop solution
- pUC19 DNA, 10 pg/ μ l
- Chemically competent *E. coli* cells (competence: $\geq 1 \times 10^7$ CFU/ μ g), 400 μ l.
- LB Plates containing ampicillin (100 μ g/ml) and methicillin (200 μ g/ml) \pm X-gal and IPTG (See below)

Notes:

Preparation of the Entry Clone DNA: Miniprep DNA that has been treated with RNase works well. A reasonably accurate quantitation ($\pm 50\%$) of the DNA to be cloned is advised, as the GATEWAY™ reaction appears to have an optimum of about 100-300 ng of Entry Clone per 20 μ l of reaction mix.

The positive control Entry Clone, pENTR- β -Gal, permits functional analysis of clones based on the numbers of expected blue vs. white colonies on LB plates containing IPTG + Blueo-gal (or X-gal), in addition to ampicillin (100 μ g/ml) and methicillin (200 μ g/ml). Because β -Galactosidase is a large protein, it often yields a less prominent band than many smaller proteins do on SDS protein gels.

In the Positive Control Entry Vector pENTR- β -Gal, the coding sequence of β -Gal has been cloned into pENTR11 (Figures 20A and 20B), with translational start signals permitting expression in *E. coli*, as well as in eukaryotic

cells. The positive control Destination Vector, for example pDEST1 (Figure 21), is preferably linearized.

To prepare X-gal + IPTG plates, either of the following protocols may be used:

5 A. With a glass rod, spread over the surface of an LB agar plate: 40 μ l of 20 mg/ml X-gal (or Bluo-gal) in DMF plus 4 μ l 200 mg/ml IPTG. Allow liquid to adsorb into agar for 3-4 hours at 37° C before plating cells.

10 B. To liquid LB agar at ~45° C, add: X-gal (or Bluo-Gal) (20 mg/ml in DMF) to make 50 μ g/ml and IPTG (200 mM in water) to make 0.5-1 mM, just prior to pouring plates. Store X-gal and Bluo-Gal in a light-shielded container.

15 Colony color may be enhanced by placing the plates at 5° C for a few hours after the overnight incubation at 37° C. Protocol B can give more consistent colony color than A, but A is more convenient when selection plates are needed on short notice.

20 Recombination in Clonase reactions continues for many hours. While incubations of 45-60 minutes are usually sufficient, reactions with large DNAs, or in which both parental DNAs are supercoiled, or which will be transformed into cells of low competence, can be improved with longer incubation times, such as 2-24 hours at 25° C.

Procedure:

25 1. Assemble reactions as follows (combine all components at room temperature, except GATEWAY™ LR Clonase™ Enzyme Mix ("Clonase LR"), before removing Clonase LR from frozen storage):

Component	Tube 1	Tube 2	Tube 3	Tube 4
	Neg.	Pos.	Neg.	Test
p-Gate- β Gal, (Positive control Entry Clone) 75 ng/ μ l	4 μ l	4 μ l		
pDEST1 (Positive control Destination Vector), 75 ng/ μ l	4 μ l	4 μ l		
Your Entry Clone (100-300 ng)			1 - 8 μ l	1 - 8 μ l
Destination Vector for your nucleic acid molecule, 75 ng/ μ l			4 μ l	4 μ l
5 X LR Reaction Buffer	4 μ l	4 μ l	4 μ l	4 μ l
TE	8 μ l	4 μ l	To 20 μ l	To 16 μ l
GATEWAY™ LR Clonase™ Enzyme Mix (store at - 80° C, add last)	---	4 μ l	---	4 μ l
Total Volume	20 μ l	20 μ l	20 μ l	20 μ l

2. Remove the GATEWAY™ LR Clonase™ Enzyme Mix from the -80° C freezer, place immediately on ice. The Clonase takes only a few minutes to thaw.
3. Add 4 μ l of GATEWAY™ LR Clonase™ Enzyme Mix to reactions #2 and #4;
4. Return GATEWAY™ LR Clonase™ Enzyme Mix to - 80° C freezer.
5. Incubate tubes at 25° for at least 60 minutes.
6. Add 2 μ l Clonase Stop solution to all reactions. Incubate for 20 min at 37°C. (This step usually increases the total number of colonies obtained by 10-20 fold.)
7. Transform 2 μ l into 100 μ l competent *E. coli*. Select on plates containing ampicillin at 100 μ g/ml.

Example 7: Transformation of *E. coli*

To introduce cloning or Expression Vectors prepared using the recombinational cloning system of the invention, any standard *E. coli* transformation protocol should be satisfactory. The following steps are recommended for best results:

1. Let the mixture of competent cells and Recombinational Cloning System reaction product stand on ice at least 15 minutes prior to the heat-shock step. This gives time for the recombination proteins to dissociate from the DNA, and improves the transformation efficiency.

2. Expect the reaction to be about 1%-5% efficient, i.e., 2 μ l of the reaction should contain at least 100 pg of the Expression Clone plasmid (taking into account the amounts of each parental plasmid in the reaction, and the subsequent dilution). If the E. coli cells have a competence of 10^7 CFU/ μ g, 100 pg of the desired clone plasmid will give about 1000 colonies, or more, if the entire transformation is spread on one ampicillin plate.

3. Always do a control pUC DNA transformation. If the number of colonies is not what you expect, the pUC DNA transformation gives you an indication of where the problem was.

Example 8: Preparation of attB-PCR Product

For preparation of attB-PCR products in the PCR cloning methods described in Example 9 below, PCR primers containing attB1 and attB2 sequences are used. The attB1 and attB2 primer sequences are as follows:

attB1: 5'-GGGGACAAGTTTGTACAAAAAAGCAGGCT-(template-specific sequence)-3'

attB2: 5'-GGGGACCACTTTGTACAAGAAAGCTGGGT-(template-specific sequence)-3'

The attB1 sequence should be added to the amino primer, and the attB2 sequence to the carboxy primer. The 4 guanines at the 5' ends of each of these primers enhance the efficiency of the minimal 25 bp attB sequences as substrates for use in the cloning methods of the invention.

Standard PCR conditions may be used to prepare the PCR product. The following suggested protocol employs PLATINUM *Taq* DNA Polymerase High

Fidelity®, available commercially from Life Technologies, Inc. (Rockville, MD). This enzyme mix eliminates the need for hot starts, has improved fidelity over Taq, and permits synthesis of a wide range of amplicon sizes, from 200 bp to 10 kb, or more, even on genomic templates.

Materials needed:

- PLATINUM Taq DNA Polymerase High Fidelity® (Life Technologies, Inc.)
- attB1- and attB2- containing primer pair (see above) specific for your template
- DNA template (linearized plasmid or genomic DNA)
- 10X High Fidelity PCR Buffer
- 10 mM dNTP mix
- PEG/MgCl₂ Mix (30% PEG 8000, 30 mM MgCl₂)

Procedure:

1.) Assemble the reaction as follows:

Component	Reaction with <u>Plasmid Target</u>	Reaction with <u>Genomic Target</u>
10X High Fidelity PCR Buffer	5 µl	5 µl
dNTP Mix 10 mM	1 µl	1 µl
MgSO ₄ , 50mM	2 µl	2 µl
attB1 Primer, 10 µM	2 µl	1 µl
attB2 Primer, 10 µM	2 µl	1 µl
Template DNA	1-5 ng*	≥ 100 ng
PLATINUM Taq High Fidelity	2 µl	1 µl
Water	to 50 µl	to 50 µl

* Use of higher amounts of plasmid template may permit fewer cycles (10-15) of PCR

2.) Add 2 drops mineral oil, as appropriate.

3.) Denature for 30 sec. at 94°C.

4.) Perform 25 cycles:

94°C for 15 sec-30 sec

55°C for 15 sec-30 sec

68°C for 1 min per kb of template.

5.) Following the PCR reaction, apply 1-2 µl of the reaction mixture to an agarose gel, together with size standards (*e.g.*, 1 Kb Plus Ladder, Life Technologies, Inc.) and quantitation standards (*e.g.*, Low Mass Ladder, Life Technologies, Inc.), to assess the yield and uniformity of the product.

Purification of the PCR product is recommended, to remove attB primer dimers which can clone efficiently into the Entry Vector. The following protocol is fast and will remove DNA <300 bp in size:

6.) Dilute the 50 µl PCR reaction to 200 µl with TE.

7.) Add 100 µl PEG/MgCl₂ Solution. Mix and centrifuge immediately at 13,000 RPM for 10 min at room temperature. Remove the supernatant (pellet is clear and hard to see).

8.) Dissolve the pellet in 50 µl TE and check recovery on a gel.

If the starting PCR template is a plasmid that contains the gene for Kan^r, it is advisable to treat the completed PCR reaction with the restriction enzyme *DpnI*, to degrade the plasmid since unreacted residual starting plasmid is a potential source of false-positive colonies from the transformation of the GATEWAY™ Cloning System reaction. Adding ~5 units of *DpnI* to the completed PCR reaction and incubating for 15 min at 37°C will eliminate this potential problem. Heat inactivate the *DpnI* at 65°C for 15 min, prior to using the PCR product in the GATEWAY™ Cloning System reaction.

Example 9: Cloning attB-PCR products into Entry Vectors via the BP ("Gateway") Reaction

The addition of 5'-terminal attB sequences to PCR primers allows synthesis of a PCR product that is an efficient substrate for recombination with a Donor (attP) Plasmid in the presence of GATEWAY™ BP Clonase™ Enzyme Mix. This reaction produces an Entry Clone of the PCR product (See Figure 8).

The conditions of the Gateway Cloning reaction with an attB PCR substrate are similar to those of the BP Reaction (see Example 10 below), except that the attB-PCR product (see Example 8) substitutes for the Expression Clone, and the attB-PCR positive control (attB-tet^r) substitutes for the Expression Clone Positive Control (GFP).

Materials needed:

- 5 X BP Reaction Buffer
- Desired attB-PCR product DNA, 50-100 ng in $\leq 8 \mu\text{l}$ TE.
- Donor (attP) Plasmid (Figures 49-54), 75 ng/ μl , supercoiled DNA
- attB-tet^r PCR product positive control, 25 ng/ μl
- GATEWAY™ BP Clonase™ Enzyme Mix (stored at -80°C)
- 10x Clonase Stop Solution
- pUC19 DNA, 10 pg/ μl .
- Chemically competent E.coli cells (competence: $\geq 1 \times 10^7$ CFU/ μg), 400 μl

Notes:

- Preparation of attB-PCR DNA: see Example 8.
- The Positive Control attB-tet^r PCR product contains a functional copy of the tet^r gene of pBR322, with its own promoter. By plating the transformation of the control BP Reaction on kanamycin (50 $\mu\text{g/ml}$) plates (if kan^r Donor Plasmids are used; see Figures 49-52) or an alternative selection agent (e.g., gentamycin, if gen^r Donor Plasmids are used; see Figure 54), and then picking about 50 of these colonies onto plates with tetracycline (20 $\mu\text{g/ml}$), the

percentage of Entry Clones containing functional tet^r among the colonies from the positive control reaction can be determined (% Expression Clones = (number of tet^r + kan^r (or gen^r) colonies/kan^r (or gen^r) colonies).

Procedure:

1. Assemble reactions as follows. Combine all components except GATEWAY™ BP Clonase™ Enzyme Mix, before removing GATEWAY™ BP Clonase™ Enzyme Mix from frozen storage.

Component	Neg.	Pos.	Test
	Tube 1	Tube 2	Tube 3
attB-PCR product, 50-100 ng			1 - 8 µl
Donor (attP) Plasmid 75 ng/µl	2 µl	2 µl	2 µl
attB-PCR tet ^r control DNA (75 ng/µl)		4 µl	
5 X BP Reaction Buffer	4 µl	4 µl	4 µl
TE	10 µl	6 µl	To 16 µl
GATEWAY™ BP Clonase™ Enzyme Mix (store at -80° C, add last)	4 µl	4 µl	4 µl
Total Volume	20 µl	20 µl	20 µl

2. Remove the GATEWAY™ BP Clonase™ Enzyme Mix from the -80° C freezer, place immediately on ice. The Clonase takes only a few minutes to thaw.
3. Add 4 µl of GATEWAY™ BP Clonase™ Enzyme Mix to the subcloning reaction, mix.
4. Return GATEWAY™ BP Clonase™ Enzyme Mix to - 80° C freezer.
5. Incubate tubes at 25° for at least 60 minutes.

6. Add 2 μ l Proteinase K (2 μ g/ μ l) to all reactions. Incubate for 20 min at 37°C.
7. Transform 2 μ l into 100 μ l competent *E. coli*, as per 3.2, above. Select on LB plates containing kanamycin, 50 μ g/ml.

Results:

In initial experiments, primers for amplifying tetR and ampR from pBR322 were constructed containing only the tetR- or ampR-specific targeting sequences, the targeting sequences plus attB1 (for forward primers) or attB2 (for reverse primers) sequences shown in Figure 9, or the attB1 or attB2 sequences with a 5' tail of four guanines. The construction of these primers is depicted in Figure 65. After PCR amplification of tetR and ampR from pBR322 using these primers and cloning the PCR products into host cells using the recombinational cloning system of the invention, the results shown in Figure 66 were obtained. These results demonstrated that primers containing attB sequences provided for a somewhat higher number of colonies on the tetracycline and ampicillin plates. However, inclusion of the 5' extensions of four or five guanines on the primers in addition to the attB sequences provided significantly better cloning results, as shown in Figures 66 and 67. These results indicate that the optimal primers for cloning of PCR products using recombinational cloning will contain the recombination site sequences with a 5' extension of four or five guanine bases.

To determine the optimal stoichiometry between attB-containing PCR products and attP-containing Donor plasmid, experiments were conducted where the amount of PCR product and Donor plasmid were varied during the BP Reaction. Reaction mixtures were then transformed into host cells and plated on tetracycline plates as above. Results are shown in Figure 68. These results indicate that, for optimal recombinational cloning results with a PCR product in the size range of the tet gene, the amounts of attP-containing Donor plasmids are between about 100-500 ng (most preferably about 200-300 ng), while the optimal concentrations of attB-containing PCR products is about 25-100 ng (most preferably about 100 ng), per 20 μ l reaction.

Experiments were then conducted to examine the effect of PCR product size on efficiency of cloning via the recombinational cloning approach of the invention.

PCR products containing attB1 and attB2 sites, at sizes 256 bp, 1 kb, 1.4 kb, 3.4 kb, 4.6 kb, 6.9 kb and 10.1 kb were prepared and cloned into Entry vectors as described above, and host cells were transformed with the Entry vectors containing the cloned PCR products. For each PCR product, cloning efficiency was calculated relative to cloning of pUC19 positive control plasmids as follows:

$$\text{Cloning Efficiency} = \frac{\text{CFU/ng attB PCR product}}{\text{CFU/ng pUC19 control}} \times \frac{\text{Size (kb) PCR product}}{\text{Size (kb) pUC19 control}}$$

The results of these experiments are depicted in Figures 69A-69C (for 256 bp PCR fragments), 70A-70C (for 1 kb PCR fragments), 71A-71C (for 1.4 kb PCR fragments), 72A-72C (for 3.4 kb PCR fragments), 73A-73C (for 4.6 kb PCR fragments), 74 (for 6.9 kb PCR fragments), and 75-76 (for 10.1 kb PCR fragments). The results shown in these figures are summarized in Figure 77, for different weights and moles of input PCR DNA.

Together, these results demonstrate that attB-containing PCR products ranging in size from about 0.25 kb to about 5 kb clone relatively efficiently in the recombinational cloning system of the invention. While PCR products larger than about 5 kb clone less efficiently (apparently due to slow resolution of cointegrates), longer incubation times during the recombination reaction appears to improve the efficiency of cloning of these larger PCR fragments. Alternatively, it may also be possible to improve efficiency of cloning of large (> about 5 kb) PCR fragments by using lower levels of input attP Donor plasmid and perhaps attB-containing PCR product, and/or by adjusting reaction conditions (*e.g.*, buffer conditions) to favor more rapid resolution of the cointegrates.

Example 10: The BP Reaction

One purpose of the Gateway ("Entry") reaction is to convert an Expression Clone into an Entry Clone. This is useful when you have isolated an individual Expression Clone from an Expression Clone cDNA library, and you wish to transfer the nucleic acid molecule of interest into another Expression Vector, or

to move a population of molecules from an attB or attL library. Alternatively, you may have mutated an Expression Clone and now wish to transfer the mutated nucleic acid molecule of interest into one or more new Expression Vectors. In both cases, it is necessary first to convert the nucleic acid molecule of interest to an Entry Clone.

Materials needed:

- 5 X BP Reaction Buffer
- Expression Clone DNA, 100-300 ng in ≤ 8 μ l TE.
- Donor (attP) Vector, 75 ng/ μ l, supercoiled DNA
- Positive control attB-tet-PCR DNA, 25 ng/ μ l
- GATEWAY™ BP Clonase™ Enzyme Mix (stored at - 80°C)
- Clonase Stop Solution (Proteinase K, 2 μ g/ μ l).

Notes:

Preparation of the Expression Clone DNA: Miniprep DNA treated with RNase works well.

1. As with the LR Reaction (see Example 14), the BP Reaction is strongly influenced by the topology of the reacting DNAs. In general, the reaction is most efficient when one of the DNAs is linear and the other is supercoiled, compared to reactions where the DNAs are both linear or both supercoiled. Further, linearizing the attB Expression Clone (anywhere within the vector) will usually give more colonies than linearizing the Donor (attP) Plasmid. If finding a suitable cleavage site within your Expression Clone vector proves difficult, you may linearize the Donor (attP) Plasmid between the attP1 and attP2 sites (for example, at the *Nco*I site), avoiding the *ccdB* gene. Maps of Donor (attP) Plasmids are given in Figures 49-54.

Procedure:

1. Assemble reactions as follows. Combine all components at room temperature, except GATEWAY™ BP Clonase™ Enzyme Mix, before removing GATEWAY™ BP Clonase™ Enzyme Mix from freezer.

	Neg.	Pos.	Test
Component	Tube 1	Tube 2	Tube 3
Positive Control, attB-tet-PCR DNA, 25 ng/ μ l	4 μ l	4 μ l	
Desired attB Expression Clone DNA (100ng) linearized			1 - 8 μ l
Donor (attP) Plasmid, 75 ng/ μ l	2 μ l	2 μ l	2 μ l
5 X BP Reaction Buffer	4 μ l	4 μ l	4 μ l
TE	10 μ l	6 μ l	To 16 μ l
GATEWAY™ BP Clonase™ Enzyme Mix (store at - 80° C, add last)	---	4 μ l	4 μ l
Total Volume	20 μ l	20 μ l	20 μ l

2. Remove the GATEWAY™ BP Clonase™ Enzyme Mix from the -80°C freezer, place immediately on ice. The mixture takes only a few minutes to thaw.
3. Add 4 μ l of GATEWAY™ BP Clonase™ Enzyme Mix to the subcloning reaction, mix.
4. Return GATEWAY™ BP Clonase™ Enzyme Mix to - 80° C freezer.
5. Incubate tubes at 25° for at least 60 minutes. If both the attB and attP DNAs are supercoiled, incubation for 2-24 hours at 25°C is recommended.
6. Add 2 μ l Clonase Stop Solution. Incubate for 10 min at 37°C.
7. Transform 2 μ l into 100 μ l competent E. coli, as above. Select on LB plates containing 50 μ g/ml kanamycin.

Example 11: Cloning PCR Products into Entry Vectors using Standard Cloning Methods

Preparation of Entry Vectors for Cloning of PCR Products

All of the Entry Vectors of the invention contain the death gene ccdB as a stuffer between the "left" and "right" restriction sites. The advantage of this arrangement is that there is virtually no background from vector that has not been cut with both restriction enzymes, because the presence of the ccdB gene will kill

all standard E. coli strains. Thus it is necessary to cut each Entry Vector twice, to remove the ccdB fragment.

We strongly recommend that, after digestion of the Entry Vector with the second restriction enzyme, you treat the reaction with phosphatase (calf intestine alkaline phosphatase, CIAP or thermosensitive alkaline phosphatase, TSAP). The phosphatase can be added directly to the reaction mixture, incubated for an additional time, and inactivated. This step dephosphorylates both the vector and ccdB fragments, so that during subsequent ligation there is less competition between the ccdB fragment and the DNA of interest for the termini of the Entry Vector.

Blunt Cloning of PCR products

Generally PCR products do not have 5' phosphates (because the primers are usually 5' OH), and they are not necessarily blunt. (On this latter point, see Brownstein, et al., *BioTechniques* 20: 1006, 1996 for a discussion of how the sequence of the primers affects the addition of single 3' bases.) The following protocol repairs these two defects.

In a 0.5 ml tube, ethanol precipitate about 40 ng of PCR product (as judged from an agarose gel).

1. Dissolve the precipitated DNA in 10 μ l comprising 1 μ l 10 mM rATP, 1 μ l mixed 2 mM dNTPs (i.e., 2 mM each dATP, dCTP, dTTP, and dGTP), 2 μ l 5x T4 polynucleotide kinase buffer (350 mM Tris HCl (pH7.6), 50 mM $MgCl_2$, 500mM KCl, 5 mM 2-mercaptoethanol) 10 units T4 polynucleotide kinase, 1 μ l T4 DNA polymerase, and water to 10 μ l.
2. Incubate the tube at 37° for 10 minutes, then at 65° for 15 minutes, cool, centrifuge briefly to bring any condensate to the tip of the tube.
3. Add 5 μ l of the PEG/ $MgCl_2$ solution, mix and centrifuge at room temperature for 10 minutes. Discard supernatant.
4. Dissolve the invisible precipitate in 10 μ l containing 2 μ l 5x T4 DNA ligase buffer (Life Technologies, Inc.), 0.5 units T4 DNA ligase, and about 50 ng of blunt, phosphatase-treated Entry Vector.

5. Incubate at 25° for 1 hour, then 65° for 10 minutes. Add 90 µl TE, transform 10 µl into 50 - 100 µl competent *E. coli* cells.
6. Plate on kanamycin.

5 **Note:** In the above protocol, steps b-c simultaneously polish the ends of the PCR product (through the exonuclease and polymerase activities of T4 DNA polymerase) and phosphorylate the 5' ends (using T4 polynucleotide kinase). It is necessary to inactivate the kinase, so that the blunt, dephosphorylated vector in step e cannot self ligate. Step d (the PEG precipitation) removes all small
10 molecules (primers, nucleotides), and has also been found to improve the yield of cloned PCR product by 50 fold.

Cloning PCR Products after Digestion with Restriction Enzymes

Efficient cloning of PCR products that have been digested with restriction
15 enzymes includes three steps: inactivation of *Taq* DNA polymerase, efficient restriction enzyme cutting, and removal of small DNA fragments.

Inactivation of Taq DNA Polymerase: Carryover of *Taq* DNA polymerase and dNTPs into a RE digestion significantly reduces the success in cloning a PCR product (D. Fox et al., *FOCUS* 20(1):15, 1998), because *Taq* DNA polymerase
20 can fill in sticky ends and add bases to blunt ends. Either TAQQUENCH™ (obtainable from Life Technologies, Inc.; Rockville, Maryland) or extraction with phenol can be used to inactivate the *Taq*.

Efficient Restriction Enzyme Cutting: Extra bases on the 5' end of each PCR primer help the RE cut near ends of PCR products. With the availability of
25 cheap primers, adding 6 to 9 bases on the 5' sides of the restriction sites is a good investment to ensure that most of the ends are digested. Incubation of the DNA with a 5-fold excess of restriction enzyme for an hour or more helps ensure success.

Removal of Small Molecules before Ligation: Primers, nucleotides,
30 primer dimers, and small fragments produced by the restriction enzyme digestion,

can all inhibit or compete with the desired ligation of the PCR product to the cloning vector. This protocol uses PEG precipitation to remove small molecules.

Protocol for cutting the ends of PCR products with restriction enzyme(s):

1. Inactivation of Taq DNA polymerase in the PCR product:

Option A: Extraction with Phenol

A1. Dilute the PCR reaction to 200 μ l with TE. Add an equal volume of phenol:chloroform:isoamyl alcohol, vortex vigorously for 20 seconds, and centrifuge for 1 minute at room temperature. Discard the lower phase.

A2. Extract the phenol from the DNA and concentrate as follows. Add an equal volume of 2-butanol (colored red with "Oil Red O" from Aldrich, if desired), vortex briefly, centrifuge briefly at room temperature. Discard the upper butanol phase. Repeat the extraction with 2-butanol. This time the volume of the lower aqueous phase should decrease significantly. Discard the upper 2-butanol phase.

A3. Ethanol precipitate the DNA from the aqueous phase of the above extractions. Dissolve in a 200 μ l of a suitable restriction enzyme (RE) buffer.

Option B: Inactivation with TaqQuench

B1. Ethanol precipitate an appropriate amount of PCR product (100 ng to 1 μ g), dissolve in 200 μ l of a suitable RE buffer.

B2. Add 2 μ l TaqQuench.

2. Add 10 to 50 units of restriction enzyme and incubate for at least 1 hour. Ethanol precipitate if necessary to change buffers for digestion at the other end of the PCR product.

3. Add ½ volume of the PEG/MgCl₂ mix to the RE digestion. Mix well and immediately centrifuge at room temperature for 10 minutes. Discard the supernatant (pellet is usually invisible), centrifuge again for a few seconds, discard any remaining supernatant.

4. Dissolve the DNA in a suitable volume of TE (depending on the amount of PCR product in the original amplification reaction) and apply an aliquot to an agarose gel to confirm recovery. Apply to the same gel 20-100 ng of the appropriate Entry Vector that will be used for the cloning.

Example 12: Determining The Expected Size of the GATEWAY™ Cloning Reaction Products

If you have access to a software program that will electronically cut and splice sequences, you can create electronic clones to aid you in predicting the sizes and restriction patterns of GATEWAY™ Cloning System recombination products.

The cleavage and ligation steps performed by the enzyme Int in the GATEWAY™ Cloning System recombination reactions mimic a restriction enzyme cleavage that creates a 7-bp 5'-end overhang followed by a ligation step that reseals the ends of the daughter molecules. The recombination proteins present in the Clonase cocktails (see Example 19 below) recognize the 15 bp core sequence present within all four types of att sites (in addition to other flanking sequences characteristic of each of the different types of att sites).

By treating these sites in your software program as if they were restriction sites, you can cut and splice your Entry Clones with various Destination Vectors and obtain accurate maps and sequences of the expected results from your GATEWAY™ Cloning System reactions.

Example 13: Protein Expression

Brief Review of Protein Expression

Transcription: The most commonly used promoters in *E. coli* Expression Vectors are variants of the lac promoter, and these can be turned on by adding

5 IPTG to the growth medium. It is usually good to keep promoters off until expression is desired, so that the host cells are not made sick by the overabundance of some heterologous protein. This is reasonably easy in the case of the lac promoters used in *E. coli*. One needs to supply the *lac I* gene (or its more productive relative, the *lac I^q* gene) to make *lac* repressor protein, which binds near the promoter and keeps transcription levels low. Some Destination Vectors for *E. coli* expression carry their own *lacI^q* gene for this purpose. (However, lac promoters are always a little "on," even in the absence of IPTG.)

10 Controlling transcription in eukaryotic cells is not nearly so straightforward or efficient. The tetracycline system of Bujard and colleagues is the most successful approach, and one of the Destination Vectors (pDEST11; Figure 31) has been constructed to supply this function.

15 *Translation:* Ribosomes convert the information present in mRNA into protein. Ribosomes scan RNA molecules looking for methionine (AUG) codons, which begin nearly all nascent proteins. Ribosomes must, however, be able to distinguish between AUG codons that code for methionine in the middle of proteins from those at the start. Most often ribosomes choose AUGs that are 1) first in the RNA (toward the 5' end), and 2) have the proper sequence context. In *E. coli* the favored context (first recognized by Shine and Dalgarno, *Eur. J. Biochem.* 57: 221 (1975)) is a run of purines (As and Gs) from five to 12 bases upstream of the initiating AUG, especially AGGAGG or some variant.

20 In eukaryotes, a survey of translated mRNAs by Kozak (*J. Biol. Chem.* 266: 19867 (1991)) has revealed a preferred sequence context, gcc Acc ATGG, around the initiating methionine, with the A at -3 being most important, and a purine at +4 (where the A of the ATG is +1), preferably a G, being next most influential. Having an A at -3 is enough to make most ribosomes choose the first AUG of an mRNA, in plants, insects, yeast, and mammals. (For a review of initiation of protein synthesis in eukaryotic cells, see: Pain, V.M. *Eur. J. Biochem.* 236:747-771, 1996.)

25 *Consequences of Translation Signals for GATEWAY™ Cloning System:* First, translation signals (Shine-Dalgarno in *E. coli*, Kozak in eukaryotes) have to be close to the initiating ATG. The attB site is 25 base pairs long. Thus if

translation signals are desired near the natural ATG of the nucleic acid molecule of interest, they must be present in the Entry Clone of that nucleic acid molecule of interest. Also, when a nucleic acid molecule of interest is moved from an Entry Clone to a Destination vector, any translation signals will move along. The result is that the presence or absence of Shine-Dalgarno and/or Kozak sequences in the Entry Clone must be considered, with the eventual Destination Vectors to be used in mind.

Second, although ribosomes choose the 5' ATG most often, internal ATGs are also used to begin protein synthesis. The better the translation context around this internal ATG, the more internal translation initiation will be seen. This is important in the GATEWAY™ Cloning System, because you can make an Entry Clone of your nucleic acid molecule of interest, and arrange to have Shine-Dalgarno and/or Kozak sequences near the ATG. When this cassette is recombined into a Destination Vector that transcribes your nucleic acid molecule of interest, you get native protein. If you want, you can make a fusion protein in a different Destination Vector, since the Shine-Dalgarno and/or Kozak sequences do not contain any stop signals in the same reading frame. However, the presence of these internal translation signals may result in a significant amount of native protein being made, contaminating, and lowering the yield of, your fusion protein. This is especially likely with short fusion tags, like His6.

A good compromise can be recommended. If an Entry Vector like pENTR7 (Figure 16) or pENTR8 (Figure 17) is chosen, the Kozak bases are present for native eukaryotic expression. The context for *E. coli* translation is poor, so the yield of an amino-terminal fusion should be good, and the fusion protein can be digested with the TEV protease to make near-native protein following purification.

Recommended Conditions for Synthesis of Proteins in E. coli: When making proteins in *E. coli* it is advisable, at least initially, to incubate your cultures at 30°C, instead of at 37°C. Our experience indicates that proteins are less likely to form aggregates at 30°C. In addition, the yields of proteins from cells grown at 30°C frequently are improved.

The yields of proteins that are difficult to express may also be improved by inducing the cultures in mid-log phase of growth, using cultures begun in the morning from overnight growths, as opposed to harvesting directly from an overnight culture. In the latter case, the cells are preferably in late log or stationary growth, which can favor the formation of insoluble aggregates.

Example 14: Constructing Destination Vectors from Existing Vectors

Destination Vectors function because they have two recombination sites, attR1 and attR2, flanking a chloramphenicol resistance (CmR) gene and a death gene, ccdB. The GATEWAY™ Cloning System recombination reactions exchange the entire Cassette (except for a few bases comprising part of the attB sites) for the DNA segment of interest from the Entry Vector. Because attR1, CmR, ccdB gene, and attR2 are contiguous, they can be moved on a single DNA segment. If this Cassette is cloned into a plasmid, the plasmid becomes a Destination Vector. Figure 63 shows a schematic of the GATEWAY™ Cloning System Cassette; attR cassettes in all three reading frames contained in vectors pEYC15101, pEYC15102 and pEYC15103 are shown in Figures 64A, 64B, and 64C, respectively.

The protocol for constructing a Destination Vector is presented below. Keep in mind the following points:

- Destination Vectors must be constructed and propagated in one of the DB strains of *E. coli* (e.g., DB3.1, and particularly *E. coli* LIBRARY EFFICIENCY® DB3.1™ Competent Cells) available from Life Technologies, Inc. (and described in detail in U.S. Provisional Application No. 60/122,392, filed on March 2, 1999, which is incorporated herein by reference), because the ccdB death gene will kill any *E. coli* strain that has not been mutated such that it will survive the presence of the ccdB gene.
- If your Destination Vector will be used to make a fusion protein, a GATEWAY™ Cloning System cassette with the correct reading frame must be used. The nucleotide sequences of the ends of the cassettes are shown in Figure 78. The reading frame of the fusion protein domain must

be in frame with the core region of the attR1 site (for an amino terminal fusion) so that the six As are translated into two lysine codons. For a C-terminal fusion protein, translation through the core region of the attR2 site should be in frame with -TAC-AAA-, to yield -Tyr-Lys-.

- Note that each reading frame Cassette has a different unique restriction site between the chloramphenicol resistance and ccdB genes (*Mlu*I for reading frame A, *Bgl*III for reading frame B, and *Xba*I for reading frame C; see Figure 63).
- Most standard vectors can be converted to Destination Vectors, by inserting the Entry Cassette into the MCS of that vector.

Protocol for Making a Destination Vector

1. If the vector will make an amino fusion protein, it is necessary to keep the “aaa aaa” triplets in attR1 in phase with the triplets of the fusion protein. Determine which Entry cassette to use as follows:

a.) Write out the nucleotide sequence of the existing vector near the restriction site into which the Entry cassette will be cloned. These must be written in triplets corresponding to the amino acid sequence of the fusion domain.

b.) Draw a vertical line through the sequence that corresponds to the restriction site end, after it has been cut and made blunt, i.e., after filling in a protruding 5' end or polishing a protruding 3' end.

c.) Choose the appropriate reading frame cassette:

- If the coding sequence of the blunt end ends after a complete codon triplet, use the reading frame A cassette. See Figures 78, 79 and 80.

- If the coding sequence of the blunt end ends in a single base, use the reading frame B cassette. See Figures 78, 79 and 81.

- If the coding sequence of the blunt end ends in two bases, use the reading frame C cassette. See Figures 78, 79, 82A-B, and 83A-C.

2. Cut one to five micrograms of the existing plasmid at the position where you wish your nucleic acid molecule of interest (flanked by att sites) to be after the recombination reactions. **Note:** it is better to remove as many of the MCS restriction sites as possible at this step. This makes it more likely that restriction enzyme sites within the GATEWAY™ Cloning System Cassette will be unique in the new plasmid, which is important for linearizing the Destination Vector (Example 14, below).

3. Remove the 5' phosphates with alkaline phosphatase. While this is not mandatory, it increases the probability of success.

4. Make the end(s) blunt with fill-in or polishing reactions. For example, to 1 µg of restriction enzyme-cut, ethanol-precipitated vector DNA, add:

- 20 µl 5x T4 DNA Polymerase Buffer (165 mM Tris-acetate (pH 7.9), 330 mM Na acetate, 50 mM Mg acetate, 500 µg/ml BSA, 2.5 mM DTT)
- 5 µl 10mM dNTP mix
- 1 Unit of T4 DNA Polymerase
- Water to a final volume of 100 µl
- Incubate for 15 min at 37°C.

5. Remove dNTPs and small DNA fragments: Ethanol precipitate (add three volumes of room temperature ethanol containing 0.1 M sodium acetate, mix well, immediately centrifuge at room temperature 5 - 10 minutes), dissolve wet precipitate in 200 µl TE, add 100 µl 30% PEG 8000, 30 mM MgCl₂, mix well,

immediately centrifuge for 10 minutes at room temperature, discard supernatant, centrifuge again a few seconds, discard any residual liquid.

5 6. Dissolve the DNA to a final concentration of 10 - 50 ng per microliter. Apply 20 - 100 ng to a gel next to supercoiled plasmid and linear size standards to confirm cutting and recovery. The cutting does not have to be 100% complete, since you will be selecting for the chloramphenicol marker on the Entry cassette.

10 7. In a 10 μ l ligation reaction combine 10 - 50 ng vector, 10 - 20 ng of Entry Cassette (Figure 79), and 0.5 units T4 DNA ligase in ligase buffer. After one hour (or overnight, whichever is most convenient), transform 1 μ l into one of the DB strains of competent *E. coli* cells with a *gyrA462* mutation (See U.S. Provisional Application No. 60/122,392, filed on March 2, 1999, which is incorporated herein by reference), preferably DB3.1, and most preferably *E. coli* LIBRARY EFFICIENCY®DB3.1™ Competent Cells. The *ccdB* gene on the Entry Cassette will kill other strains of *E. coli* that have not been mutated so as to survive the presence of the *ccdB* gene.

20 8. After expression in SOC medium, plate 10 μ l and 100 μ l on chloramphenicol-containing (30 μ g / ml) plates, incubate at 37° C.

25 9. Pick colonies, make miniprep DNA. Treat the miniprep with RNase A and store in TE. Cut with the appropriate restriction enzyme to determine the orientation of the Cassette. Choose clones with the attR1 site next to the amino end of the protein expression function of the plasmid.

Notes on Using Destination Vectors

- We have found that about ten-fold more colonies result from a GATEWAY™ Cloning System reaction if the Destination Vector is linear or relaxed. If the competent cells you use are highly competent ($>10^8$ per microgram), linearizing the Destination Vector is less essential.

- The site or sites used for the linearization must be within the Entry Cassette. Sites that cut once or twice within each cassette are shown in Figures 80-82.
- Minipreps of Destination Vectors will work fine, so long as they have been treated with RNase. Since most DB strains are *endA*- (See U.S. Provisional Application No. 60/122,392, filed on March 2, 1999, which is incorporated herein by reference), minipreps can be digested with restriction enzymes without a prior phenol extraction.
- Reading the OD₂₆₀ of miniprep DNA is inaccurate unless the RNA and ribonucleotides have been removed, for example, by a PEG precipitation.

Example 15: Some Options in Choosing Appropriate Entry Vectors and Destination Vectors: An Example

In some applications, it may be desirable to express a nucleic acid molecule of interest in two forms: as an amino-terminal fusion in *E. coli*, and as a native protein in eukaryotic cells. This may be accomplished in any of several ways:

Option 1: Your choices depend on your nucleic acid molecule of interest and the fragment that contains it, as well as the available Entry Vectors. For eukaryotic translation, you need consensus bases according to Kozak (*J. Biol. Chem.* 266:19867, 1991) near the initiating methionine (ATG) codon. All of the Entry Vectors offer this motif upstream of the *XmnI* site (blunt cutter). One option is to amplify your nucleic acid molecule of interest, with its ATG, by PCR, making the amino end blunt and the carboxy end containing the natural stop codon followed by one of the "right side" restriction sites (*EcoRI*, *NotI*, *XhoI*, *EcoRV*, or *XbaI* of the pENTR vectors).

If you know your nucleic acid molecule of interest does not have, for example, an *XhoI* site, you can make a PCR product that has this structure:

Xho I

```

5' ATG nnn nnn --- nnn TAA ctc gag nnn nnn 3'
3' tac nnn nnn --- nnn att gag ctc nnn nnn 5'
  
```

After cutting with *Xho*I, the fragment is ready to clone:

```
5' ATG nnn nnn --- nnn TAA c      3'
3' tac nnn nnn --- nnn att gag ct  5'
```

(If you follow this example, don't forget to put a phosphate on the amino oligo.)

Option 2: This PCR product could be cloned into two Entry Vectors to give the desired products, between the *Xmn*I and *Xho*I sites: pENTR1A (Figures 10A, 10B) or pENTR7 (Figures 16A, 16B). If you clone into pENTR1A, amino fusions will have the minimal number of amino acids between the fusion domain and your nucleic acid molecule of interest, but the fusion cannot be removed with TEV protease. The converse is true of clones in pENTR7, i.e., an amino fusion can be cleaved with TEV protease, at the cost of more amino acids between the fusion and your nucleic acid molecule of interest.

In this example, let us choose to clone our hypothetical nucleic acid molecule of interest into pENTR7, between the *Xmn*I and *Xho*I sites. Once this is accomplished, several optional protocols using the Entry Clone pENTR7 may be followed:

Option 3: Since the nucleic acid molecule of interest has been amplified with PCR, it may be desirable to sequence it. To do this, transfer the nucleic acid molecule of interest from the Entry Vector into a vector that has priming sites for the standard sequencing primers. Such a vector is pDEST6 (Figures 26A, 26B). This Destination Vector places the nucleic acid molecule of interest in the opposite orientation to the lac promoter (which is leaky -- see Example 3 above). If the gene product is toxic to *E. coli*, this Destination Vector will minimize its toxicity.

Option 4: While the sequencing is going on, you might wish to check the expression of the nucleic acid molecule of interest in, for example, CHO cells, by recombining the nucleic acid molecule of interest into a CMV promoter vector (pDEST7, Figure 27; or pDEST12, Figure 32), or into a baculovirus vector (pDEST8, Figure 28; or pDEST10, Figure 30) for expression in insect cells. Both

of these vectors will transcribe the coding sequence of your nucleic acid molecule of interest, and translate it from the ATG of the PCR product using the Kozak bases upstream of the *Xmn*I site.

Option 5: If you wish to purify protein, for example to make antibodies, you can clone the nucleic acid molecule of interest into a His6 fusion vector, pDEST2 (Figure 22). Since the nucleic acid molecule of interest is cloned downstream of the TEV protease cleavage domain of pENTR7 (Figure 16), the amino acid sequence of the protein produced will be:

[----- attB1 -----] TEV protease
NH2- MSYYHHHHHHGITSLYKKAGFENLYFQ↓ GTM----COOH

The attB site and the restriction sites used to make the Destination and Entry Vectors are translated into the underlined 11 amino acids (GITSLYKKAGF). Cleavage with TEV protease (arrow) leaves two amino acids, GT, on the amino end of the gene product.

See Figure 55 for an example of a nucleic acid molecule of interest, the chloramphenicol acetyl transferase (CAT) gene, cloned into pENTR7 (Figure 16) as a blunt (amino)-*Xho*I (carboxy) fragment, then cloned by recombination into the His6 fusion vector pDEST2 (Figure 22).

Option 6: If the His6 fusion protein is insoluble, you may go on and try a GST fusion. The appropriate Destination vector is pDEST3 (Figure 23).

Option 7: If you need to make RNA probes and prefer SP6 RNA polymerase, you can make the top strand RNA with your nucleic acid molecule of interest cloned into pSPORT+ (pDEST5 (Figures 25A, 25B)), and the bottom strand RNA with the nucleic acid molecule of interest cloned into pSPORT(-) (pDEST6 (Figures 26A, 26B)). Opposing promoters for T7 RNA polymerase and SP6 RNA polymerase are also present in these clones.

Option 8: It is often worthwhile to clone your nucleic acid molecule of interest into a variety of Destination Vectors in the same experiment. For example, if the number of colonies varies widely when the various recombination reactions are transformed into *E. coli*, this may be an indication that the nucleic acid molecule of interest is toxic in some contexts. (This problem is more clearly evident when a positive control gene is used for each Destination Vector.) Specifically, if many more colonies are obtained when the nucleic acid molecule of interest is recombined into pDEST6 than in pDEST5, there is a good chance that leakiness of the lac promoter is causing some expression of the nucleic acid molecule of interest in pSPORT "+" (which is not harmful in pDEST6 because the nucleic acid molecule of interest is in the opposite orientation).

Example 16: Demonstration of a One-tube Transfer of a PCR Product (or Expression Clone) to Expression Clone via a Recombinational Cloning Reaction

In the BxP recombination (Entry or Gateway) reaction described herein, a DNA segment flanked by attB1 and attB2 sites in a plasmid conferring ampicillin resistance was transferred by recombination into an attP plasmid conferring kanamycin resistance, which resulted in a product molecule wherein the DNA segment was flanked by attL sites (attL1 and attL2). This product plasmid comprises an "attL Entry Clone" molecule, because it can react with a "attR Destination Vector" molecule via the LxR (Destination) reaction, resulting in the transfer of the DNA segment to a new (ampicillin resistant) vector. In the previously described examples, it was necessary to transform the BxP reaction products into *E. coli*, select kanamycin resistant colonies, grow those colonies in liquid culture, and prepare miniprep DNA, before reacting this DNA with a Destination Vector in an LxR reaction.

The goal of the following experiment was to eliminate the transformation and miniprep DNA steps, by adding the BxP Reaction products directly to an LxR Reaction. This is especially appropriate when the DNA segment flanked by attB sites is a PCR product instead of a plasmid, because the PCR product cannot give

ampicillin-resistant colonies upon transformation, whereas attB plasmids (in general) carry an ampicillin resistance gene. Thus use of a PCR product flanked by attB sites in a BxP Reaction allows one to select for the ampicillin resistance encoded by the desired attB product of a subsequent LxR Reaction.

Two reactions were prepared: Reaction A, negative control, no attB PCR product, (8 μ l) contained 50 ng pEZC7102 (attP Donor plasmid, confers kanamycin resistance) and 2 μ l BxP Clonase (22 ng / μ l Int protein and 8 ng/ μ l IHF protein) in BxP buffer (25 mM Tris HCl, pH 7.8, 70 mM KCl, 5 mM spermidine, 0.5 mM EDTA, 250 μ g / ml BSA). Reaction B (24 μ l) contained 150 ng pEZC7102, 6 μ l BxP Clonase, and 120 ng of the attB -tet-PCR product in the same buffer as reaction A. The attB - tet - PCR product comprised the tetracycline resistance gene of plasmid pBR322, amplified with two primers containing either attB1 or attB2 sites, and having 4 Gs at their 5' ends, as described earlier.

The two reactions were incubated at 25°C for 30 minutes. Then aliquots of these reactions were added to new components that comprised LxR Reactions or appropriate controls for the LxR Reaction. Five new reactions were thus produced:

Reaction 1: 5 μ l of reaction A was added to a 5 μ l LxR Reaction containing 25 ng *Nco*I-cut pEZC8402 (the attR Destination Vector plasmid) in LxR buffer (37.5 mM Tris HCl, pH 7.7, 16.5 mM NaCl, 35 mM KCl, 5 mM spermidine, 375 μ g / ml BSA), and 1 μ l of GATEWAY™ LR Clonase™ Enzyme Mix (total volume of 10 μ l).

Reaction 2: Same as reaction 1, except 5 μ l of reaction B (positive) were added instead of reaction A (negative).

Reaction 3: Same as reaction 2, except that the amounts of *Nco*-cut pEZC8402 and GATEWAY™ LR Clonase™ Enzyme Mix were doubled, to 50 ng and 2 μ l, respectively.

Reaction 4: Same as reaction 2, except that 25 ng of pEZ11104 (a positive control attL Entry Clone plasmid) were added in addition to the aliquot of reaction B.

Reaction 5: Positive control LxR Reaction, containing 25 ng *Nco*I-cut pEYC8402, 25 ng pEZ11104, 37.5 mM Tris HCl pH 7.7, 16.5 mM NaCl, 35 mM KCl, 5 mM spermidine, 375 µg / ml BSA and 1 µl GATEWAY™ LR Clonase™ Enzyme Mix in a total volume of 5 µl.

All five reactions were incubated at 25°C for 30 minutes. Then, 1 µl aliquots of each of the above five reactions, plus 1 µl from the remaining volume of Reaction B, the standard BxP Reaction, were used to transform 50 µl competent DH5α *E. coli*. DNA and cells were incubated on ice for 15 min., heat shocked at 42°C for 45 sec., and 450 µl SOC were added. Each tube was incubated with shaking at 37°C for 60 min. Aliquots of 100 µl and 400 µl of each transformation were plated on LB plates containing either 50 µg/ml kanamycin or 100 µg/ml ampicillin (see Table 2). A transformation with 10 pg of pUC19 DNA (plated on LB-amp₁₀₀) served as a control on the transformation efficiency of the DH5α cells. Following incubation overnight at 37°C, the number of colonies on each plate was determined.

Results of these reactions are shown in Table 2.

Table 2*

Reaction No.	1	2	3	4	5	6
	Number of Colonies					
Vol. plated:	Neg. Control BxP Reaction	1X pEYC8402 and LR Clonase™	2X pEYC8402 and LR Clonase™	LxR Reaction with Pos. Control DNA	LxR Reaction alone	BxP Reaction alone
100 µl	2	1	8	9	~1000	~1000
400 µl	5	10	35	62	>2000	>2000
Selection:	Kan	Amp	Amp	Amp	Amp	Kan

*(Transformation with pUC 19 DNA yielded 1.4×10^9 CFU/µg DNA.)

34 of the 43 colonies obtained from Reaction 3 were picked into 2 ml Terrific Broth with 100 µg/ml ampicillin and these cultures were grown overnight, with shaking, at 37°C. 27 of the 34 cultures gave at least moderate growth, and of these 24 were used to prepare miniprep DNA, using the standard protocol. These 24 DNAs were initially analyzed as supercoiled (SC) DNA on a 1% agarose gel to identify those with inserts and to estimate the sizes of the inserts. Fifteen of the 24 samples displayed SC DNA of the size predicted (5553 bp) if **tetx7102** had correctly recombined with **pEJC8402** to yield **tetx8402**. One of these samples contained two plasmids, one of ~5500 bp and a one of ~3500 bp. The majority of the remaining clones were approximately 4100 bp in size.

All 15 of the clones displaying SC DNA of predicted size (~5500 bp) were analyzed by two different double digests with restriction endonucleases to confirm the structure of the expected product: **tetx8402**. (See plasmid maps, Figures 57-59) In one set of digests, the DNAs were treated with Not I and Eco RI, which should cut the predicted product just outside both attB sites, releasing the tet^r insert on a fragment of 1475 bp. In the second set of digests, the DNAs were digested with *NotI* and with *NruI*. *NruI* cleaves asymmetrically within the subcloned tet^r insert, and together with *NotI* will release a fragment of 1019 bp.

Of the 15 clones analyzed by double restriction digestion, 14 revealed the predicted sizes of fragments for the expected product.

Interpretation:

The DNA components of Reaction B, **pEJC7102** and attB-tet-PCR, are shown in Figure 56. The desired product of BxP Reaction B is **tetx7102**, depicted in Figure 57. The LxR Reaction recombines the product of the BxP Reaction, **tetx7102** (Figure 57), with the Destination Vector, **pEJC8402**, shown in Figure 58. The LxR Reaction with **tetx7102** plus **pEJC8402** is predicted to yield the desired product **tetx8402**, shown in Figure 59.

Reaction 2, which combined the BxP Reaction and LxR Reaction, gave few colonies beyond those of the negative control Reaction. In contrast, Reaction 3, with twice the amount of **pEJC8402** (Figure 58) and LxR Clonase, yielded a

larger number of colonies. These colonies were analyzed further, by restriction digestion, to confirm the presence of expected product. Reaction 4 included a known amount of attL Entry Clone plasmid in the combined BxP-plus-LxR reaction. But reaction 4 yielded only about 1% of the colonies obtained when the same DNA was used in a LxR reaction alone, Reaction 6. This result suggests that the LxR reaction may be inhibited by components of the BxP reaction.

Restriction endonuclease analysis of the products of Reaction 3 revealed that a sizeable proportion of the colonies (14 of the 34 analyzed) contained the desired tet^r subclone, tetx8402 (Figure 59).

The above results establish the feasibility of performing first a BxP recombination reaction followed by a LxR recombination reaction -- in the same tube -- simply by adding the appropriate buffer mix, recombination proteins, and DNAs to a completed BxP reaction. This method should prove useful as a faster method to convert attB-containing PCR products into different Expression Clones, eliminating the need to isolate first the intermediate attL-PCR insert subclones, before recombining these with Destination Vectors. This may prove especially valuable for automated applications of these reactions.

This same one-tube approach allows for the rapid transfer of nucleic acid molecules contained in attB plasmid clones into new functional vectors as well. As in the above examples, attL subclones generated in a BxP Reaction can be recombined directly with various Destination Vectors in a LxR reaction. The only additional requirement for using attB plasmids, instead of attB-containing PCR products, is that the Destination Vector(s) employed must contain a different selection marker from the one present on the attB plasmid itself and the attP vector.

Two alternative protocols for a one-tube reaction have also proven useful and somewhat more optimal than the conditions described above.

Alternative 1:

Reaction buffer contained 50 mM Tris-HCl (pH 7.5), 50 mM NaCl, 0.25 mM EDTA, 2.5 mM spermidine, and 200 µg/ml BSA. After a 16 (or 3) hour incubation of the PCR product (100 ng) + attP Donor plasmid (100 ng) +

GATEWAY™ BP Clonase™ Enzyme Mix + Destination Vector (100 ng), 2 µl of GATEWAY™ LR Clonase™ Enzyme Mix (per 10 µl reaction mix) was added and the mixture was incubated an additional 6 (or 2) hours at 25°C. Stop solution was then added as above and the mixture was incubated at 37°C as above and transformed by electroporation with 1 µl directly into electrocompetent host cells. Results of this series of experiments demonstrated that longer incubation times (16 hours vs. 3 hours for the BP Reaction, 6 hours vs. 2 hours for the LR Reaction) resulted in about twice as many colonies being obtained as for the shorter incubation times. With two independent genes, 10/10 colonies having the correct cloning patterns were obtained.

Alternative 2:

A standard BP Reaction under the reaction conditions described above for Alternative 1 was performed for 2 hours at 25°C. Following the BP Reaction, the following components were added to the reaction mixture in a total volume of 7 µl:

20 mM Tris-HCl, pH 7.5

100 mM NaCl

5 µg/ml Xis-His6

15% glycerol

~1000 ng of Destination Vector

The reaction mixture was then incubated for 2 hours at 25°C, and 2.5 µl of stop solution (containing 2 µg/ml proteinase K) was added and the mixture was incubated at 37°C for an additional 10 minutes. Chemically competent host cells were then transformed with 2 µl of the reaction mixture, or electrocompetent host cells (*e.g.*, EMax DH10B cells; Life Technologies, Inc.) were electroporated with 2 µl of the reaction mixture per 25-40 µl of cells. Following transformation, mixtures were diluted with SOC, incubated at 37°C, and plated as described above on media selecting for the selection markers on the Destination Vector and the Entry clone (B x P reaction product). Analogous results to those described for Alternative 1 were obtained with these reaction conditions -- a higher level of colonies containing correctly recombined reaction products were observed.

Example 17: Demonstration of a One-tube Transfer of a PCR Product (or Expression Clone) to Expression Clone via a Recombinational Cloning Reaction

5 Single-tube transfer of PCR product DNA or Expression Clones into Expression Clones by recombinational cloning has also been accomplished using a procedure modified from that described in Example 16. This procedure is as follows:

10 •Perform a standard BP (Gateway) Reaction (see Examples 9 and 10) in 20 µl volume at 25°C for 1 hour.

15 •After the incubation is over, take a 10 µl aliquot from the 20 µl total volume and add 1 µl of Proteinase K (2 mg/ml) and incubate at 37°C for 10 minutes. This first aliquot can be used for transformation and gel assay of BP reaction analysis. Plate BP reaction transformation on LB plates with **Kanamycin** (50 µg/ml).

20 •Add the following reagents to the remaining 10 µl aliquot of the BP reaction:

20 1 µl of 0.75 M NaCl

 2 µl of destination vector (150 ng/µl)

 4 µl of LR Clonase™ (after thawing and brief mixing)

25 •Mix all reagents well and incubate at 25°C for 3 hours. Stop the reaction at the end of incubation with 1.7 µl of Proteinase K (2 mg/ml) and incubate at 37°C for 10 minutes.

30 •Transform 2 µl of the completed reaction into 100 µl of competent cells. Plate 100 µl and 400 µl on LB plates with **Ampicillin** (100 µg/ml).

Notes:

•If your competent cells are less than 10⁸ CFU/µg, and you are concerned about getting enough colonies, you can improve the yield several fold by incubating the

BP reaction for 6-20 hours. Electroporation also can yield better colony output than chemical transformation.

•PCR products greater than about 5-6 kb show significantly lower cloning efficiency in the BP reaction. In this case, we recommend using longer incubation times for both BP and LR steps.

•If you want to move your insert gene into several destination vectors simultaneously, then scale up the initial BP reaction volume so that you have a 10 µl aliquot for adding each destination vector.

Example 18: Optimization of GATEWAY™ Clonase™ Enzyme Compositions

The enzyme compositions containing Int and IHF (for BP Reactions) were optimized using a standard functional recombinational cloning reaction (a BP reaction) between attB-containing plasmids and attP-containing plasmids, according to the following protocol:

Materials and Methods:

Substrates:

AttP - supercoiled pDONR201

AttB - linear ~ 1Kb [³H]PCR product amplified from pEZC7501

Proteins:

IntH6 -- His₆-carboxy- tagged λ Integrase

IHF -- Integration Host Factor

Clonase:

50 ng/µl IntH6 and 20 ng/µl IHF, admixed in 25 mM Tris- HCl (pH 7.5), 22 mM NaCl, 5 mM EDTA, 1 mg/ml BSA, 5 mM Spermidine, and 50% glycerol.

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Reaction Mixture (total volume of 40 μ l):

1000 ng AttP plasmid

600 ng AttB [3 H] PCR product

8 μ l Clonase (400 ng IntH6, 160 ng IHF) in 25 mM Tris-HCl (pH 7.5),
22 mM NaCl, 5 mM EDTA, 1 mg/ml BSA, 5 mM Spermidine, 5 mM
DTT.

Reaction mixture was incubated for 1 hour at 25°C, 4 μ l of 2 μ g/ μ l
proteinase K was added and mixture was incubated for an additional 20 minutes
at 37°C. Mixture was then extracted with an equal volume of Phenol/Chloroform/
Isoamyl alcohol. The aqueous layer was then collected, and 0.1 volumes of 3 M
sodium acetate and 2 volumes of cold 100% ethanol were added. Tubes were
then spun in a microcentrifuge at maximum RPM for 10 minutes at room
temperature. Ethanol was decanted, and pellets were rinsed with 70% ethanol and
re-centrifuged as above. Ethanol was decanted, and pellets were allowed to air
dry for 5-10 minutes and then dissolved in 20 μ l of 33 mM Tris-Acetate (pH 7.8),
66 mM potassium acetate, 10 mM magnesium acetate, 1 mM DTT, and 1mM
ATP. 2 units of exonuclease V (*e.g.*, Plasmid Safe; EpiCentre, Inc., Madison, WI)
was then added, and the mixture was incubated at 37°C for 30 minutes.

Samples were then TCA-washed by spotting 30 μ l of reaction mixture
onto a Whatman GF/C filter, washing filters once with 10% TCA + 1% NaPPi for
10 minutes, three times with 5% TCA for 5 minutes each, and twice with ethanol
for 5 minutes each. Filters were then dried under a heat lamp, placed into a
scintillation vial, and counted on a β liquid scintillation counter (LSC).

The principle behind this assay is that, after exonuclease V digestion, only
double-stranded circular DNA survives in an acid-insoluble form. All DNA
substrates and products that have free ends are digested to an acid-soluble form
and are not retained on the filters. Therefore, only the 3 H-labeled attB linear DNA
which ends up in circular form after both inter- and intramolecular integration is
complete is resistant to digestion and is recovered as acid-insoluble product.
Optimal enzyme and buffer formulations in the Clonase compositions therefore are
those that give the highest levels of circularized 3 H-labeled attB-containing

sequences, as determined by highest cpm in the LSC. Although this assay was designed for optimization of GATEWAY™ BP Clonase™ Enzyme Mix compositions (Int + IHF), the same type of assay may be performed to optimize GATEWAY™ LR Clonase™ Enzyme Mix compositions (Int + IHF + Xis), except that the reaction mixtures would comprise 1000 ng of AttR (instead of AttP) and 600 ng of AttL (instead of AttB), and 40 ng of His₆-carboxy- tagged Xis (XisH6) in addition to the IntH6 and IHF.

Example 19: Testing Functionality of Entry and Destination Vectors

As part of assessment of the functionality of particular vectors of the invention, it is important to functionally test the ability of the vectors to recombine. This assessment can be carried out by performing a recombinational cloning reaction (as schematized in Figures 2, 4, and 5A and 5B, and as described herein and in commonly owned U.S. Application Nos. 08/486,139, filed June 7, 1995, 08/663,002, filed June 7, 1996 (now U.S. Patent No. 5,888,732), 09/005,476, filed January 12, 1998, and 09/177,387, filed October 23, 1998, the disclosures of all of which are incorporated by reference herein in their entireties), by transforming E. coli and scoring colony forming units. However, an alternative assay may also be performed to allow faster, more simple assessment of the functionality of a given Entry or Destination Vector by agarose gel electrophoresis. The following is a description of such an in vitro assay.

Materials and Methods:

Plasmid templates pEZX1301 (Figure 84) and pEZX1313 (Figure 85), each containing a single wild type att site, were used for the generation of PCR products containing attL or attR sites, respectively. Plasmid templates were linearized with *A*1wNI, phenol extracted, ethanol precipitated and dissolved in TE to a concentration of 1 ng/μl.

PCR primers (capital letters represent base changes from wildtype):

attL1 gggg agcct gctttttGtacAaa gttggcatta taaaaaagca ttgc
attL2 gggg agcct gctttCttGtacAaa gttggcatta taaaaaagca ttgc
attL right tgttgccggg aagctagagt aa

attR1 gggg Acaag ttTgtaCaaaaaagc tgaacgaga aacgtaaaat
attR2 gggg Acaag ttTgtaCaaGaaagc tgaacgaga aacgtaaaat
attR right ca gacggcatga tgaacctgaa

PCR primers were dissolved in TE to a concentration of 500 pmol/ μ l. Primer mixes were prepared, consisting of attL1 + attLright primers, attL2 + attLright primers, attR1 + attRright primers, and attR2 + attRright primers, each mix containing 20 pmol/ μ l of each primer.

PCR reactions:

1 μ l plasmid template (1 ng)
1 μ l primer pairs (20 pmoles of each)
3 μ l of H₂O
45 μ l of Platinum PCR SuperMix® (Life Technologies, Inc.)

Cycling conditions (performed in MJ thermocycler):

95°C/2 minutes
94°C/30 seconds
25 cycles of 58°C/30 seconds and 72°C/1.5 minutes
72°C/5 minutes
5°C/hold

The resulting attL PCR product was 1.5 kb, and the resulting attR PCR product was 1.0 kb.

PCR reactions were PEG/MgCl₂ precipitated by adding 150 μ l H₂O and 100 μ l of 3x PEG/ MgCl₂ solution followed by centrifugation. The PCR products were dissolved in 50 μ l of TE. Quantification of the PCR product was performed by gel electrophoresis of 1 μ l and was estimated to be 50-100 ng/ μ l.

Recombination reactions of PCR products containing attL or attR sites with GATEWAY™ plasmids was performed as follows:

8 µl of H₂O

2 µl of attL or attR PCR product (100-200 ng)

2 µl of GATEWAY™ plasmid (100 ng)

4 µl of 5x Destination buffer

4 µl of GATEWAY™ LR Clonase™ Enzyme Mix

20 µl total volume (the reactions can be scaled down to a 5 µl total volume by adjusting the volumes of the components to about ¼ of those shown above, while keeping the stoichiometries the same).

Clonase reactions were incubated at 25°C for 2 hours. 2 µl of proteinase K (2 mg/ml) was added to stop the reaction. 10 µl was then run on a 1 % agarose gel. Positive control reactions were performed by reacting attL1 PCR product (1.0 kb) with attR1 PCR product (1.5 kb) and by similarly reacting attL2 PCR product with attR2 PCR product to observe the formation of a larger (2.5 kb) recombination product. Negative controls were similarly performed by reacting attL1 PCR product with attR2 PCR product and vice versa or reactions of attL PCR product with an attL plasmid, etc.

In alternative assays, to test attB Entry vectors, plasmids containing single attP sites were used. Plasmids containing single att sites could also be used as recombination substrates in general to test all Entry and Destination vectors (*i.e.*, those containing attL, attR, attB and attP sites). This would eliminate the need to do PCR reactions.

Results:

Destination and Entry plasmids when reacted with appropriate att-containing PCR products formed linear recombinant molecules that could be easily visualized on an agarose gel when compared to control reactions containing no attL or attR PCR product. Thus, the functionality of Destination and Entry vectors constructed according to the invention may be determined either by carrying out the Destination or Entry recombination reactions as depicted in

Figures 2, 4, and 5A and 5B, or more rapidly by carrying out the linearization assay described in this Example.

Example 20: PCR Cloning Using Universal Adapter-Primers

As described herein, the cloning of PCR products using the GATEWAY™ PCR Cloning System (Life Technologies, Inc.; Rockville, MD) requires the addition of attB sites (attB1 and attB2) to the ends of gene-specific primers used in the PCR reaction. The protocols described in the preceding Examples suggest that the user add 29 bp (25 bp containing the attB site plus four G residues) to the gene-specific primer. It would be advantageous to high volume users of the GATEWAY™ PCR Cloning System to generate attB-containing PCR product using universal attB adapter-primers in combination with shorter gene-specific primers containing a specified overlap to the adapters. The following experiments demonstrate the utility of this strategy using universal attB adapter-primers and gene-specific primers containing overlaps of various lengths from 6 bp to 18 bp. The results demonstrate that gene-specific primers with overlaps of 10 bp to 18 bp can be used successfully in PCR amplifications with universal attB adapter-primers to generate full-length PCR products. These PCR products can then be successfully cloned with high fidelity in a specified orientation using the GATEWAY™ PCR Cloning System.

Methods and Results:

To demonstrate that universal attB adapter-primers can be used with gene-specific primers containing partial attB sites in PCR reactions to generate full-length PCR product, a small 256 bp region of the human hemoglobin cDNA was chosen as a target so that intermediate sized products could be distinguished from full-length products by agarose gel electrophoresis.

The following oligonucleotides were used:

B1-Hgb: GGGG ACA AGT TTG TAC AAA AAA GCA GGC T-5'-Hgb*
B2-Hgb: GGGG ACC ACT TTG TAC AAG AAA GCT GGG T-3'-Hgb**

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18B1-Hgb: TG TAC AAA AAA GCA GGC T-5'-Hgb
 18B2-Hgb: TG TAC AAG AAA GCT GGG T-3'-Hgb
 15B1-Hgb: AC AAA AAA GCA GGC T-5'-Hgb
 15B2-Hgb: AC AAG AAA GCT GGG T-3'-Hgb
 5 12B1-Hgb: AA AAA GCA GGC T-5'-Hgb
 12B2-Hgb: AG AAA GCT GGG T-3'-Hgb
 11B1-Hgb: A AAA GCA GGC T-5'-Hgb
 11B2-Hgb: G AAA GCT GGG T-3'-Hgb
 10B1-Hgb: AAA GCA GGC T-5'-Hgb
 10 10B2-Hgb: AAA GCT GGG T-3'-Hgb
 9B1-Hgb: AA GCA GGC T-5'-Hgb
 9B2-Hgb: AA GCT GGG T-3'-Hgb
 8B1-Hgb: A GCA GGC T-5'-Hgb
 8B2-Hgb: A GCT GGG T-3'-Hgb
 15 7B1-Hgb: GCA GGC T-5'-Hgb
 7B2-Hgb: GCT GGG T-3'-Hgb
 6B1-Hgb: CA GGC T-5'-Hgb
 6B2-Hgb: CT GGG T-3'-Hgb

 20 attB1 adapter: GGGG ACA AGT TTG TAC AAA AAA GCA GGC T
 attB2 adapter: GGGG ACC ACT TTG TAC AAG AAA GCT GGG T

 * -5'-Hgb = GTC ACT AGC CTG TGG AGC AAG A
 ** -3'-Hgb = AGG ATG GCA GAG GGA GAC GAC A

25

The aim of these experiments was to develop a simple and efficient universal adapter PCR method to generate attB containing PCR products suitable for use in the GATEWAY™ PCR Cloning System. The reaction mixtures and thermocycling conditions should be simple and efficient so that the universal adapter PCR method could be routinely applicable to any PCR product cloning application.

30

PCR reaction conditions were initially found that could successfully amplify predominately full-length PCR product using gene-specific primers containing 18bp and 15 bp overlap with universal attB primers. These conditions are outlined below:

35

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10 pmoles of gene-specific primers
10 pmoles of universal attB adapter-primers
1 ng of plasmid containing the human hemoglobin cDNA.
100 ng of human leukocyte cDNA library DNA.
5 μ l of 10x PLATINUM Taq HiFi® reaction buffer (Life Technologies, Inc.)
2 μ l of 50 mM MgSO₄
1 μ l of 10 mM dNTPs
0.2 μ l of PLATINUM Taq HiFi® (1.0 unit)
H₂O to 50 μ l total reaction volume

Cycling conditions:

25 x $\left\{ \begin{array}{l} 95^{\circ}\text{C}/5 \text{ min} \\ 94^{\circ}\text{C}/15 \text{ sec} \\ 50^{\circ}\text{C}/30 \text{ sec} \\ 68^{\circ}\text{C}/1 \text{ min} \\ 68^{\circ}\text{C}/5 \text{ min} \\ 5^{\circ}\text{C}/\text{hold} \end{array} \right.$

To assess the efficiency of the method, 2 μ l (1/25) of the 50 μ l PCR reaction was electrophoresed in a 3 % Agarose-1000 gel. With overlaps of 12 bp or less, smaller intermediate products containing one or no universal attB adapter predominated the reactions. Further optimization of PCR reaction conditions was obtained by titrating the amounts of gene-specific primers and universal attB adapter-primers. The PCR reactions were set up as outlined above except that the amounts of primers added were:

0, 1, 3 or 10 pmoles of gene-specific primers
0, 10, 30 or 100 pmoles of adapter-primers

Cycling conditions:

25 x		95°C/3 min
		94°C/15 sec
		50°C/45 sec
		68°C/1 min
		68°C/5 min
		5°C/hold

The use of limiting amounts of gene-specific primers (3 pmoles) and excess adapter-primers (30 pmoles) reduced the amounts of smaller intermediate products. Using these reaction conditions the overlap necessary to obtain predominately full-length PCR product was reduced to 12 bp. The amounts of gene-specific and adapter-primers was further optimized in the following PCR reactions:

0, 1, 2 or 3 pmoles of gene-specific primers
0, 30, 40 or 50 pmoles of adapter-primers

Cycling conditions:

25 x

95°C/3 min
94°C/15 sec
48°C/1 min
68°C/1 min
68°C/5 min
5°C/hold

The use of 2 pmoles of gene-specific primers and 40 pmoles of adapter-primers further reduced the amounts of intermediate products and generated predominately full-length PCR products with gene-specific primers containing an 11 bp overlap. The success of the PCR reactions can be assessed in any PCR application by performing a no adapter control. The use of limiting amounts of gene-specific primers should give faint or barely visible bands when 1/25 to 1/10 of the PCR reaction is electrophoresed on a standard agarose gel. Addition of the

universal attB adapter-primers should generate a robust PCR reaction with a much higher overall yield of product.

PCR products from reactions using the 18 bp, 15 bp, 12 bp, 11 bp and 10 bp overlap gene-specific primers were purified using the CONCERT® Rapid PCR Purification System (PCR products greater than 500 bp can be PEG precipitated). The purified PCR products were subsequently cloned into an attP containing plasmid vector using the GATEWAY™ PCR Cloning System (Life Technologies, Inc.; Rockville, MD) and transformed into *E. coli*. Colonies were selected and counted on the appropriate antibiotic media and screened by PCR for correct inserts and orientation.

Raw PCR products (unpurified) from the attB adapter PCR of a plasmid clone of part of the human beta-globin (Hgb) gene were also used in GATEWAY™ PCR Cloning System reactions. PCR products generated with the full attB B1/B2-Hgb, the 12B1/B2, 11B1/B2 and 10B1/B2 attB overlap Hgb primers were successfully cloned into the GATEWAY™ pENTR21 attP vector (Figure 49). 24 colonies from each (24 x 4 = 96 total) were tested and each was verified by PCR to contain correct inserts. The cloning efficiency expressed as cfu/ml is shown below:

Primer Used	cfu/ml
Hgb full attB	8,700
Hgb 12 bp overlap	21,000
Hgb 11 bp overlap	20,500
Hgb 10 bp overlap	13,500
GFP control	1,300

Interestingly, the overlap PCR products cloned with higher efficiency than did the full attB PCR product. Presumably, and as verified by visualization on agarose gel, the adapter PCR products were slightly cleaner than was the full attB PCR product. The differences in colony output may also reflect the proportion of PCR product molecules with intact attB sites.

Using the attB adapter PCR method, PCR primers with 12 bp attB overlaps were used to amplify cDNAs of different sizes (ranging from 1 to 4 kb)

from a leukocyte cDNA library and from first strand cDNA prepared from HeLa total RNA. While three of the four cDNAs were able to be amplified by this method, a non-specific amplification product was also observed that under some conditions would interfere with the gene-specific amplification. This non-specific product was amplified in reactions containing the attB adapter-primers alone without any gene-specific overlap primers present. The non-specific amplification product was reduced by increasing the stringency of the PCR reaction and lowering the attB adapter PCR primer concentration.

These results indicate that the adapter-primer PCR approach described in this Example will work well for cloned genes. These results also demonstrate the development of a simple and efficient method to amplify PCR products that are compatible with the GATEWAY™ PCR Cloning System that allows the use of shorter gene-specific primers that partially overlap universal attB adapter-primers. In routine PCR cloning applications, the use of 12 bp overlaps is recommended. The methods described in this Example can thus reduce the length of gene-specific primers by up to 17 residues or more, resulting in a significant savings in oligonucleotide costs for high volume users of the GATEWAY™ PCR Cloning System. In addition, using the methods and assays described in this Example, one of ordinary skill can, using only routine experimentation, design and use analogous primer-adapters based on or containing other recombination sites or fragments thereof, such as *attL*, *attR*, *attP*, *lox*, FRT, etc.

Example 21: Mutational Analysis of the Bacteriophage Lambda attL and attR Sites: Determinants of att Site Specificity in Site-specific Recombination

To investigate the determinants of *att* site specificity, the bacteriophage lambda *attL* and *attR* sites were systematically mutagenized. As noted herein, the determinants of specificity have previously been localized to the 7 bp overlap region (TTTATAC, which is defined by the cut sites for the integrase protein and is the region where strand exchange takes place) within the 15 bp core region (GCTTTTTTTATACTAA) which is identical in all four lambda *att* sites, *attB*, *attP*, *attL* and *attR*. This core region, however, has not heretofore been systematically

mutagenized and examined to define precisely which mutations produce unique changes in *att* site specificity.

Therefore, to examine the effect of *att* sequence on site specificity, mutant *attL* and *attR* sites were generated by PCR and tested in an *in vitro* site-specific recombination assay. In this way all possible single base pair changes within the 7 bp overlap region of the core *att* site were generated as well as five additional changes outside the 7 bp overlap but within the 15 bp core *att* site. Each *attL* PCR substrate was tested in the *in vitro* recombination assay with each of the *attR* PCR substrates.

Methods

To examine both the efficiency and specificity of recombination of mutant *attL* and *attR* sites, a simple *in vitro* site-specific recombination assay was developed. Since the core regions of *attL* and *attR* lie near the ends of these sites, it was possible to incorporate the desired nucleotide base changes within PCR primers and generate a series of PCR products containing mutant *attL* and *attR* sites. PCR products containing *attL* and *attR* sites were used as substrates in an *in vitro* reaction with GATEWAY™ LR Clonase™ Enzyme Mix (Life Technologies, Inc.; Rockville, MD). Recombination between a 1.5 kb *attL* PCR product and a 1.0 kb *attR* PCR product resulted in a 2.5 kb recombinant molecule that was monitored using agarose gel electrophoresis and ethidium bromide staining.

Plasmid templates pEZC1301 (Figure 84) and pEZC1313 (Figure 85), each containing a single wild type *attL* or *attR* site, respectively, were used for the generation of recombination substrates. The following list shows primers that were used in PCR reactions to generate the *attL* PCR products that were used as substrates in L x R Clonase reactions (capital letters represent changes from the wild-type sequence, and the underline represents the 7 bp overlap region within the 15 bp core *att* site; a similar set of PCR primers was used to prepare the *attR* PCR products containing matching mutations):

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GATEWAY™ sites (note: attL2 sequence in GATEWAY™ plasmids begins "accca" while the attL2 site in this example begins "agcct" to reflect wild-type attL outside the core region.):

5
attL1: gggg agcct gcttttGtacAaa gttggcatta taaaaa-
agca ttgc

10
attL2: gggg agcct gcttttCttGtacAaa gttggcatta taaaaa-
agca ttgc

Wild-type:

15
attL0: gggg agcct gctttttatactaa gttggcatta taaaaa-
agca ttgc

Single base changes from wild-type:

attLT1A: gggg agcct gcttttAttatactaa gttggcatta taaaaa-
agca ttgc

20
attLT1C: gggg agcct gcttttCttatactaa gttggcatta taaaaa-
agca ttgc

attLT1G: gggg agcct gcttttGttatactaa gttggcatta taaaaa-
agca ttgc

25
attLT2A: gggg agcct gcttttAtatactaa gttggcatta taaaaa-
agca ttgc

30
attLT2C: gggg agcct gcttttCtatactaa gttggcatta taaaaa-
agca ttgc

attLT2G: gggg agcct gcttttGtatactaa gttggcatta taaaaa-
aagca ttgc

35

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attLT3A: gggg agcct gctttttAatactaa gttggcatta taaaa-
aagca ttgc

5 attLT3C: gggg agcct gctttttCatactaa gttggcatta taaaa-
aagca ttgc

10 attLT3G: gggg agcct gctttttGatactaa gttggcatta taaaa-
aagca ttgc

15 attLA4C: gggg agcct gcttttttCtactaa gttggcatta taaaa-
aagca ttgc

attLA4G: gggg agcct gcttttttGtactaa gttggcatta taaaa-
aagca ttgc

20 attLA4T: gggg agcct gcttttttTtactaa gttggcatta taaaa-
aagca ttgc

25 attLT5A: gggg agcct gcttttttAaactaa gttggcatta taaaa-
aagca ttgc

attLT5C: gggg agcct gcttttttCaactaa gttggcatta taaaa-
aagca ttgc

30 attLT5G: gggg agcct gcttttttGaactaa gttggcatta taaaa-
aagca ttgc

35 attLA6C: gggg agcct gcttttttatCctaa gttggcatta taaaa-
aagca ttgc

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attLA6G: gggg agcct gcttttttatGctaa gttggcatta taaaa-
aagca ttgc

5 attLA6T: gggg agcct gcttttttatTctaa gttggcatta taaaa-
aagca ttgc

10 attLC7A: gggg agcct gcttttttataAtaa gttggcatta taaaa-
aagca ttgc

15 attLC7G: gggg agcct gcttttttataGtaa gttggcatta taaaa-
aagca ttgc

attLC7T: gggg agcct gcttttttataTtaa gttggcatta taaaa-
aagca ttgc

Single base changes outside of the 7 bp overlap:

20 attL8: gggg agcct Acttttttataactaa gttggcatta taaaa-
aagca ttgc

25 attL9: gggg agcct gCcttttttataactaa gttggcatta taaaaa-
agca ttgc

attL10: gggg agcct gcttCttttataactaa gttggcatta taaaaa-
agca ttgc

30 attL14: gggg agcct gcttttttatacCaa gttggcatta taaaaa-
agca ttgc

35 attL15: gggg agcct gcttttttataactaG gttggcatta taaaaa-
agca ttgc

Note: additional vectors wherein the first nine bases are *gggg agcca* (*i.e.*, substituting an adenine for the thymine in the position immediately preceding the 15-bp core region), which may or may not contain the single base pair substitutions (or deletions) outlined above, can also be used in these experiments.

Recombination reactions of *attL*- and *attR*-containing PCR products was performed as follows:

8 μ l of H₂O

2 μ l of *attL* PCR product (100 ng)

2 μ l of *attR* PCR product (100 ng)

4 μ l of 5x buffer

4 μ l of GATEWAY™ LR Clonase™ Enzyme Mix

20 μ l total volume

Clonase reactions were incubated at 25°C for 2 hours.

2 μ l of 10X Clonase stop solution (proteinase K, 2 mg/ml) were added to stop the reaction.

10 μ l were run on a 1 % agarose gel.

Results

Each *attL* PCR substrate was tested in the *in vitro* recombination assay with each of the *attR* PCR substrates. Changes within the first three positions of the 7 bp overlap (TTTTATAC) strongly altered the specificity of recombination. These mutant *att* sites each recombined as well as the wild-type, but only with their cognate partner mutant; they did not recombine detectably with any other *att* site mutant. In contrast, changes in the last four positions (TTTATAC) only partially altered specificity; these mutants recombined with their cognate mutant as well as wild-type *att* sites and recombined partially with all other mutant *att* sites except for those having mutations in the first three positions of the 7 bp

overlap. Changes outside of the 7 bp overlap were found not to affect specificity of recombination, but some did influence the efficiency of recombination.

Based on these results, the following rules for *att* site specificity were determined:

- Only changes within the 7 bp overlap affect specificity.
- Changes within the first 3 positions strongly affect specificity.
- Changes within the last 4 positions weakly affect specificity.

Mutations that affected the overall efficiency of the recombination reaction were also assessed by this method. In these experiments, a slightly increased (less than 2-fold) recombination efficiency with *att*LT1A and *att*LC7T substrates was observed when these substrates were reacted with their cognate *att*R partners. Also observed were mutations that decreased recombination efficiency (approximately 2-3 fold), including *att*LA6G, *att*L14 and *att*L15. These mutations presumably reflect changes that affect Int protein binding at the core *att* site.

The results of these experiments demonstrate that changes within the first three positions of the 7 bp overlap (TTTATAC) strongly altered the specificity of recombination (*i.e.*, *att* sequences with one or more mutations in the first three thymidines would only recombine with their cognate partners and would not cross-react with any other *att* site mutation). In contrast, mutations in the last four positions (TTTATAC) only partially altered specificity (*i.e.*, *att* sequences with one or more mutations in the last four base positions would cross-react partially with the wild-type *att* site and all other mutant *att* sites, except for those having mutations in one or more of the first three positions of the 7 bp overlap). Mutations outside of the 7 bp overlap were not found to affect specificity of recombination, but some were found to influence (*i.e.*, to cause a decrease in) the efficiency of recombination.

Example 22: Discovery of Att Site Mutations That Increase the Cloning Efficiency of GATEWAY™ Cloning Reactions

In experiments designed to understand the determinants of *att* site specificity, point mutations in the core region of *att*L were made. Nucleic acid molecules containing these mutated *att*L sequences were then reacted in an LR

reaction with nucleic acid molecules containing the cognate *attR* site (*i.e.*, an *attR* site containing a mutation corresponding to that in the *attL* site), and recombinational efficiency was determined as described above. Several mutations located in the core region of the att site were noted that either slightly increased (less than 2-fold) or decreased (between 2-4-fold) the efficiency of the recombination reaction (Table 3).

Table 3. *Effects of attL mutations on Recombination Reactions.*

<u>Site</u>	<u>Sequence</u>	<u>Effect on Recombination</u>
attL0	agcctgcttttttataactaagttggcatta	
attL5	agcctgcttttAttataactaagttggcatta	slightly increased
attL6	agcctgcttttttataTtaagttggcatta	slightly increased
attL13	agcctgctttttttatGctaagttggcatta	decreased
attL14	agcctgctttttttatacCaagttggcatta	decreased
attL15	agcctgctttttttataactaGgttggcatta	decreased
consensus	CAACTTnnTnnnAnnAAGTTG	

It was also noted that these mutations presumably reflected changes that either increased or decreased, respectively, the relative affinity of the integrase protein for binding the core att site. A consensus sequence for an integrase core-binding site (CAACTTNNT) has been inferred in the literature but not directly tested (see, *e.g.*, Ross and Landy, *Cell* 33:261-272 (1983)). This consensus core integrase-binding sequence was established by comparing the sequences of each of the four core att sites found in attP and attB as well as the sequences of five non-att sites that resemble the core sequence and to which integrase has been shown to bind in vitro. These experiments suggest that many more att site mutations might be identified which increase the binding of integrase to the core att site and thus increase the efficiency of GATEWAY™ cloning reactions.

Example 23: Effects of Core Region Mutations on Recombination Efficiency

To directly compare the cloning efficiency of mutations in the att site core region, single base changes were made in the attB2 site of an attB1-TET-attB2 PCR product. Nucleic acid molecules containing these mutated attB2 sequences were then reacted in a BP reaction with nucleic acid molecules containing non-cognate attP sites (*i.e.*, wildtype attP2), and recombinational efficiency was determined as described above. The cloning efficiency of these mutant attB2 containing PCR products compared to standard attB1-TET-attB2 PCR product are shown in Table 4.

Table 4. Efficiency of Recombination With Mutated attB2 Sites.

<u>Site</u>	<u>Sequence</u>	<u>Mutation</u>	<u>Cloning Efficiency</u>
attB0	tcaagttagtataaaaaagcaggct		
attB1	ggggacaagtttgtacaaaaagcaggct		
attB2	ggggaccactttgtacaagaaagctgggt		100%
attB2.1	ggggAacactttgtacaagaaagctgggt	C→A	40%
attB2.2	ggggacAactttgtacaagaaagctgggt	C→A	131%
attB2.3	ggggaccCctttgtacaagaaagctgggt	A→C	4%
attB2.4	ggggaccaAttgtacaagaaagctgggt	C→A	11%
attB2.5	ggggaccacGttgtacaagaaagctgggt	T→G	4%
attB2.6	ggggaccactGtgtacaagaaagctgggt	T→G	6%
attB2.7	ggggaccacttGgtacaagaaagctgggt	T→G	1%
attB2.8	ggggaccactttTtacaagaaagctgggt	G→T	0.5%

As noted above, a single base change in the attB2.2 site increased the cloning efficiency of the attB1-TET-attB2.2 PCR product to 131% compared to the attB1-TET-attB2 PCR product. Interestingly, this mutation changes the integrase core binding site of attB2 to a sequence that matches more closely the proposed consensus sequence.

Additional experiments were performed to directly compare the cloning efficiency of an attB1-TET-attB2 PCR product with a PCR product that contained attB sites containing the proposed consensus sequence (*see* Example 22) of an integrase core binding site. The following attB sites were used to amplify attB-TET PCR products:

attB1 ggggacaagtttgtacaaaaaagcaggct
attB1.6 ggggacaaCtttgtacaaaaaagTTggct
attB2 ggggaccactttgtacaagaaagctgggt
attB2.10 ggggacAactttgtacaagaaagTtgggt

BP reactions were carried out between 300 ng (100 fmoles) of pDONR201 (Figure 49A) with 80 ng (80 fmoles) of attB-TET PCR product in a 20 μ l volume with incubation for 1.5 hrs at 25°C, creating pENTR201-TET Entry clones. A comparison of the cloning efficiencies of the above-noted attB sites in BP reactions is shown in Table 5.

Table 5. Cloning efficiency of BP Reactions.

PCR product	CFU/ml	Fold Increase
B1-tet-B2	7,500	
B1.6-tet-B2	12,000	1.6 x
B1-tet-B2.10	20,900	2.8 x
B1.6-tet-B2.10	30,100	4.0 x

These results demonstrate that attB PCR products containing sequences that perfectly match the proposed consensus sequence for integrase core binding sites can produce Entry clones with four-fold higher efficiency than standard Gateway attB1 and attB2 PCR products.

The entry clones produced above were then transferred to pDEST20 (Figure 40A) via LR reactions (300 ng (64 fmoles) pDEST20 mixed with 50 ng (77 fmoles) of the respective pENTR201-TET Entry clone in 20 μ l volume; incubated for 1 hr incubation at 25°C). The efficiencies of cloning for these reactions are compared in Table 6.

Table 6. Cloning Efficiency of LR Reactions.

pENTR201-TET x pDEST20	CFU/ml	Fold Increase
L1-tet-L2	5,800	
L1.6-tet-L2	8,000	1.4
L1-tet-L2.10	10,000	1.7
L1.6-tet-L2.10	9,300	1.6

These results demonstrate that the mutations introduced into attB1.6 and attB2.10 that transfer with the gene into entry clones slightly increase the efficiency of LR reactions. Thus, the present invention encompasses not only mutations in *attB* sites that increase recombination efficiency, but also to the corresponding mutations that result in the *attL* sites created by the BP reaction.

To examine the increased cloning efficiency of the attB1.6-TET-attB2.10 PCR product over a range of PCR product amounts, experiments analogous to those described above were performed in which the amount of attB PCR product was titrated into the reaction mixture. The results are shown in Table 7.

Table 7. Titration of attB PCR products.

Amount of attB PCR product (ng)	PCR product	CFU/ml	Fold Increase
20	attB1-TET-attB2	3,500	6.1
	attB1.6-TET-attB2.10	21,500	
50	attB1-TET-attB2	9,800	5.0
	attB1.6-TET-attB2.10	49,000	
100	attB1-TET-attB2	18,800	2.8
	attB1.6-TET-attB2.10	53,000	
200	attB1-TET-attB2	19,000	2.5
	attB1.6-TET-attB2.10	48,000	

These results demonstrate that as much as a six-fold increase in cloning efficiency is achieved with the attB1.6-TET-attB2.10 PCR product as compared to the standard attB1-TET-attB2 PCR product at the 20 ng amount.

Example 24: Determination of attB Sequence Requirements for Optimum Recombination Efficiency

To examine the sequence requirements for attB and to determine which attB sites would clone with the highest efficiency from populations of degenerate attB sites, a series of experiments was performed. Degenerate PCR primers were designed which contained five bases of degeneracy in the B-arm of the attB site. These degenerate sequences would thus transfer with the gene into Entry clone in BP reactions and subsequently be transferred with the gene into expression clones in LR reactions. The populations of degenerate attB and attL sites could thus be cycled from attB to attL back and forth for any number of cycles. By altering the reaction conditions at each transfer step (for example by decreasing the reaction time and/or decreasing the concentration of DNA) the reaction can be made increasingly more stringent at each cycle and thus enrich for populations of attB and attL sites that react more efficiently.

The following degenerate PCR primers were used to amplify a 500 bp fragment from pUC18 which contained the lacZ alpha fragment (only the attB portion of each primer is shown):

```

attB1      GGGG ACAAGTTTGTACAAA AAAGC AGGCT
attB1n16-20 GGGG ACAAGTTTGTACAAA nnnnn AGGCT
attB1n21-25 GGGG ACAAGTTTGTACAAA AAAGC nnnnn

attB2      GGGG ACCACTTTGTACAAG AAAGC TGGGT
attB2n16-20 GGGG ACCACTTTGTACAAG nnnnn TGGGT
attB2n21-25 GGGG ACCACTTTGTACAAG AAAGC nnnnn

```

The starting population size of degenerate att sites is 4^5 or 1024 molecules. Four different populations were transferred through two BP reactions and two LR reactions. Following transformation of each reaction, the population of transformants was amplified by growth in liquid media containing the appropriate selection antibiotic. DNA was prepared from the population of clones by alkaline

lysis miniprep and used in the next reaction. The results of the BP and LR cloning reactions are shown below.

BP-1, overnight reactions

	cfu/ml	percent of control
attB1-LacZa-attB2	78,500	100 %
attB1n16-20-LacZa-attB2	1,140	1.5 %
attB1n21-25-LacZa-attB2	11,100	14 %
attB1-LacZa-attB2n16-20	710	0.9 %
attB1-LacZa-attB2n21-25	16,600	21 %

LR-1, pENTR201-LacZa x pDEST20/*EcoRI*, 1hr reactions

	cfu/ml	percent of control
attL1-LacZa-attL2	20,000	100 %
attL1n16-20-LacZa-attL2	2,125	11 %
attL1n21-25-LacZa-attL2	2,920	15 %
attL1-LacZa-attL2n16-20	3,190	16 %
attL1-LacZa-attL2n21-25	1,405	7 %

BP-2, pEXP20-LacZa/*ScaI* x pDONR 201, 1hr reactions

	cfu/ml	percent of control
attB1-LacZa-attB2	48,600	100 %
attB1n16-20-LacZa-attB2	22,800	47 %
attB1n21-25-LacZa-attB2	31,500	65 %
attB1-LacZa-attB2n16-20	42,400	87 %
attB1-LacZa-attB2n21-25	34,500	71 %

LR-2, pENTR201-LacZa x pDEST6/*NcoI*, 1hr reactions

	cfu/ml	percent of control
attL1-LacZa-attL2	23,000	100 %
attL1n16-20-LacZa-attL2	49,000	213 %
attL1n21-25-LacZa-attL2	18,000	80 %
attL1-LacZa-attL2n16-20	37,000	160 %
attL1-LacZa-attL2n21-25	57,000	250 %

These results demonstrate that at each successive transfer, the cloning efficiency of the entire population of att sites increases, and that there is a great deal of flexibility in the definition of an attB site. Specific clones may be isolated from the above reactions, tested individually for recombination efficiency, and

sequenced. Such new specificities may then be compared to known examples to guide the design of new sequences with new recombination specificities. In addition, based on the enrichment and screening protocols described herein, one of ordinary skill can easily identify and use sequences in other recombination sites, e.g., other *att* sites, *lox*, FRT, etc., that result in increased specificity in the recombination reactions using nucleic acid molecules containing such sequences.

Example 25: Design of att Site PCR Adapter-Primers

Additional studies were performed to design gene-specific primers with 12bp of attB1 and attB2 at their 5'-ends. The optimal primer design for *att*-containing primers is the same as for any PCR primers: the gene-specific portion of the primers should ideally have a T_m of $> 50^\circ\text{C}$ at 50 mM salt (calculation of T_m is based on the formula $59.9 + 41(\%GC) - 675/n$).

Primers:

12bp attB1: AA AAA GCA GGC TNN - forward gene-specific primer

12bp attB2: A GAA AGC TGG GTN - reverse gene-specific primer

attB1 adapter primer: GGGGACAAGTTTGTACAAAAAAGCAGGCT

attB2 adapter primer: GGGGACCACTTTGTACAAGAAAGCTGGGT

Protocol:

(1) Mix 200 ng of cDNA library or 1 ng of plasmid clone DNA (alternatively, genomic DNA or RNA could be used) with 10 pmoles of gene specific primers in a 50 μl PCR reaction, using one or more polypeptides having DNA polymerase activity such as those described herein. (The addition of greater than 10 pmoles of gene-specific primers can decrease the yield of attB PCR product. In addition, if RNA is used, a standard reverse transcriptase-PCR (RT-

PCR) protocol should be followed; *see, e.g.,* Gerard, G.F., *et al.*, *FOCUS* 11:60 (1989); Myers, T.W., and Gelfand, D.H., *Biochem.* 30:7661 (1991); Freeman, W.N., *et al.*, *BioTechniques* 20:782 (1996); and U.S. Application No. 09/064,057, filed April 22, 1998, the disclosures of all of which are incorporated herein by reference.)

1st PCR profile:

(a) 95°C for 3 minutes

(b) 10 cycles of:

(i) 94°C for 15 seconds

(ii) 50°C* for 30 seconds

(iii) 68°C for 1 minute/kb of target amplicon

(c) 68°C for 5 minutes

(d) 10°C hold

*The optimal annealing temperature is determined by the calculated T_m of the gene-specific part of the primer.

(2) Transfer 10 µl to a 40 µl PCR reaction mix containing 35 pmoles each of the attB1 and attB2 adapter primers.

2nd PCR profile:

(a) 95°C for 1 minute

(b) 5 cycles of:

(i) 94°C for 15 seconds

(ii) 45°C* for 30 seconds

(iii) 68°C for 1 minute/kb of target amplicon

(c) 15-20 cycles** of:

(i) 94°C for 15 seconds

(ii) 55°C* for 30 seconds

(iii) 68°C for 1 minute/kb of target amplicon

(d) 68°C for 5 minutes

(e) 10°C hold

5 *The optimal annealing temperature is determined by the calculated T_m of the gene-specific part of the primer.

**15 cycles is sufficient for low complexity targets.

Notes:

- 10 1. It is useful to perform a no-adapter primer control to assess the yield of attB PCR product produced.
2. Linearized template usually results in slightly greater yield of PCR product.

15

Example 26: One-Tube Recombinational Cloning Using the GATEWAY™ Cloning System

20 To provide for easier and more rapid cloning using the GATEWAY™ cloning system, we have designed a protocol whereby the BP and LR reactions may be performed in a single tube (a "one-tube" protocol). The following is an example of such a one-tube protocol; in this example, an aliquot of the BP reaction is taken before adding the LR components, but the BP and LR reactions may be performed in a one-tube protocol without first taking the BP aliquot:

25

<u>Reaction Component</u>	<u>Volume</u>
attB DNA (100-200 ng/25 µl reaction)	1-12.5 µl
attP DNA (pDONR201) 150 ng/µl	2.5 µl
5X BP Reaction Buffer	5.0 µl
Tris-EDTA	(to 20 µl)
<u>BP Clonase</u>	<u>5.0 µl</u>
Total vol.	25 µl

30

-165-

After the above components were mixed in a single tube, the reaction mixtures were incubated for 4 hours at 25°C. A 5 µl aliquot of reaction mixture was removed, and 0.5 µl of 10X stop solution was added to this reaction mixture and incubated for 10 minutes at 37°C. Competent cells were then transformed with 1-2 µl of the BP reaction per 100 µl of cells; this transformation yielded colonies of Entry Clones for isolation of individual Entry Clones and for quantitation of the BP Reaction efficiency.

To the remaining 20 µl of BP reaction mixture, the following components of the LR reaction were added:

<u>Reaction Component</u>	<u>Final Concentration</u>	<u>Volume Added</u>
NaCl	0.75 M	1 µl
Destination Vector	150 ng/ul	3 µl
<u>LR Clonase</u>		<u>6 µl</u>
Total vol.		30 µl

After the above components were mixed in a single tube, the reaction mixtures were incubated for 2 hours at 25°C. 3 µl of 10X stop solution was added, and the mixture was incubated for 10 minutes at 37°C. Competent cells were then transformed with 1-2 µl of the reaction mixture per 100 µl of cells.

Notes:

1. If desired, the Destination Vector can be added to the initial BP reaction.
2. The reactions can be scaled down by 2x, if desired.
3. Shorter incubation times for the BP and/or LR reactions can be used (scaled to the desired cloning efficiencies of the reaction), but a lower number of colonies will typically result.
4. To increase the number of colonies obtained by several fold, incubate the BP reaction for 6-20 hours and increase the LR reaction to 3 hours. Electroporation also works well with 1-2 ul of the PK-treated reaction mixture.

5. PCR products greater than about 5 kb may show significantly lower cloning efficiency in the BP reaction. In this case, we recommend using a one-tube reaction with longer incubation times (*e.g.*, 6-18 hours) for both the BP and LR steps.

Example 27: Relaxation of Destination Vectors During the LR Reaction

To further optimize the LR Reaction, the composition of the LR Reaction buffer was modified from that described above and this modified buffer was used in a protocol to examine the impact of enzymatic relaxation of Destination Vectors during the LR Reaction.

LR Reactions were set up as usual (*see, e.g.*, Example 6), except that 5X BP Reaction Buffer (*see* Example 5) was used for the LR Reaction. To accomplish Destination Vector relaxation during the LR Reaction, Topoisomerase I (Life Technologies, Inc., Rockville, MD; Catalogue No. 38042-016) was added to the reaction mixture at a final concentration of ~15U per μg of total DNA in the reaction (for example, for reaction mixtures with a total of 400ng DNA in the 20 μl LR Reaction, ~6units of Topoisomerase I was added).

Reaction mixtures were set up as follows:

<u>Reaction Component</u>	<u>Volume</u>
ddH ₂ O	6.5 μl
4X BP Reaction Buffer	5 μl
100ng single chain/linear pENTR CAT, 50 ng/ μl	2 μl
300ng single chain/linear pDEST6, 150ng/ μl	2 μl
Topoisomerase I, 15 U/ml	0.5 μl
LR Clonase	4 μl

Reaction mixtures were incubated at 25°C for 1 hour, and 2 μl of 2 $\mu\text{g}/\mu\text{l}$ Proteinase K was then added and mixtures incubated for 10 minutes at 37°C to stop the LR Reaction. Competent cells were then transformed as described in the preceding examples. The results of these studies demonstrated that relaxation of

substrates in the LR reaction using Topoisomerase I resulted in a 2- to 10-fold increase in colony output compared to those LR reactions performed without including Topoisomerase I.

5 Having now fully described the present invention in some detail by way of illustration and example for purposes of clarity of understanding, it will be obvious to one of ordinary skill in the art that the same can be performed by modifying or changing the invention within a wide and equivalent range of conditions, formulations and other parameters without affecting the scope of the invention or
10 any specific embodiment thereof, and that such modifications or changes are intended to be encompassed within the scope of the appended claims.

 All publications, patents and patent applications mentioned in this specification are indicative of the level of skill of those skilled in the art to which this invention pertains, and are herein incorporated by reference to the same extent
15 as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated by reference.

167.1

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A. The indications made below relate to the microorganism referred to in the description on page 52, line 31.

B. IDENTIFICATION OF DEPOSITFurther deposits are identified on an additional sheet ☒

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1815 N. University Street
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United States of America

Date of deposit
February 27, 1999

Accession Number
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C. ADDITIONAL INDICATIONS (leave blank if not applicable)This information is continued on an additional sheet ☐

Escherichia coli DB3.1(pAHPKan) or Escherichia coli DB3.1(pAttPKan)

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United States of America

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Escherichia coli DB3.1(pENTR-1A)

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Escherichia coli DB3.1(pENTR-2B)

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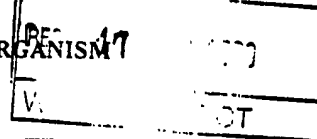
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Escherichia coli DB3.1(pEZC15101)

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Escherichia coli DB3.1(pEZC15102)	
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A. The indications made below relate to the microorganism referred to in the description on page 54, line 9.

B. IDENTIFICATION OF DEPOSIT

Further deposits are identified on an additional sheet ☒

Name of depositary institution
Agricultural Research Culture Collection (NRRL)
International Depositary Authority

Address of depositary institution (including postal code and country)

1815 N. University Street
Peoria, Illinois 61604
United States of America

Date of deposit
February 27, 1999

Accession Number
NRRL B-30105

C. ADDITIONAL INDICATIONS (leave blank if not applicable)

This information is continued on an additional sheet ☐

Escherichia coli DB3.1(pEZC15103)

D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)

E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)

The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")

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Barbara Pridmore

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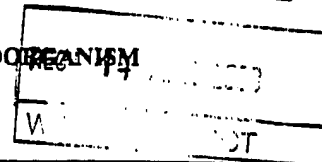
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167.8

Applicant's or agent's file reference number	0942.408PC03	International application No. 11 PCT/US 00/05432
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**INDICATIONS RELATING TO DEPOSITED MICROORGANISM
OR OTHER BIOLOGICAL MATERIAL**
(PCT Rule 13bis)



A. The indications made below relate to the microorganism referred to in the description on page 51, line 20-21.

B. IDENTIFICATION OF DEPOSIT

Further deposits are identified on an additional sheet ☒

Name of depositary institution
Agricultural Research Culture Collection (NRRL)
International Depository Authority

Address of depositary institution (including postal code and country)

1815 N. University Street
Peoria, Illinois 61604
United States of America

Date of deposit
February 27, 1999

Accession Number
NRRL B-30108

C. ADDITIONAL INDICATIONS (leave blank if not applicable)

This information is continued on an additional sheet ☐

Escherichia coli DB10B(pCMVSPORT6)

D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)

E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)

The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")

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<input checked="" type="checkbox"/> This sheet was received with the international application	<input type="checkbox"/> This sheet was received by the International Bureau on:
Authorized officer Barbara F. H. [Signature]	Authorized officer

WHAT IS CLAIMED IS:

1. An isolated nucleic acid molecule comprising a nucleotide sequence selected from the group of nucleotide sequences consisting of an attB1 nucleotide sequence as set forth in Figure 9, an attB2 nucleotide sequence as set forth in Figure 9, an attP1 nucleotide sequence as set forth in Figure 9, an attP2 nucleotide sequence as set forth in Figure 9, an attL1 nucleotide sequence as set forth in Figure 9, an attL2 nucleotide sequence as set forth in Figure 9, an attR1 nucleotide sequence as set forth in Figure 9, an attR2 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, and a mutant, fragment, or derivative thereof.

2. An isolated nucleic acid molecule comprising an attB1 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

3. An isolated nucleic acid molecule comprising an attB2 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

4. An isolated nucleic acid molecule comprising an attP1 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

5. An isolated nucleic acid molecule comprising an attP2 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

6. An isolated nucleic acid molecule comprising an attL1 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

7. An isolated nucleic acid molecule comprising an attL2 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

5 8. An isolated nucleic acid molecule comprising an attR1 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

10 9. An isolated nucleic acid molecule comprising an attR2 nucleotide sequence as set forth in Figure 9, a polynucleotide complementary thereto, or a mutant, fragment, variant or derivative thereof.

15 10. The isolated nucleic acid molecule of claim 1, further comprising one or more functional or structural nucleotide sequences selected from the group consisting of one or more multiple cloning sites, one or more localization signals, one or more transcription termination sites, one or more transcriptional regulatory sequences, one or more translational signals, one or more origins of replication, one or more fusion partner peptide-encoding nucleic acid molecules, one or more protease cleavage sites, and one or more 5' polynucleotide extensions.

20 11. The nucleic acid molecule of claim 10, wherein said transcriptional regulatory sequence is a promoter, an enhancer, or a repressor.

25 12. The nucleic acid molecule of claim 10, wherein said fusion partner peptide-encoding nucleic acid molecule encodes glutathione S-transferase (GST), hexahistidine (His₆), or thioredoxin (Trx).

30 13. The nucleic acid molecule of claim 10, wherein said 5' polynucleotide extension consists of from one to five nucleotide bases.

14. The nucleic acid molecule of claim 13, wherein said 5' polynucleotide extension consists of four or five guanine nucleotide bases.

15. A primer nucleic acid molecule suitable for amplifying a target nucleotide sequence, comprising the isolated nucleic acid molecule of claim 1 or a portion thereof linked to a target-specific nucleotide sequence useful in amplifying said target nucleotide sequence.

16. The primer nucleic acid molecule of claim 15, wherein said primer comprises an attB1 nucleotide sequence having the sequence shown in Figure 9 or a portion thereof, or a polynucleotide complementary to the sequence shown in Figure 9 or a portion thereof.

17. The primer nucleic acid molecule of claim 15, wherein said primer comprises an attB2 nucleotide sequence having the sequence shown in Figure 9 or a portion thereof, or a polynucleotide complementary to the sequence shown in Figure 9 or a portion thereof.

18. The primer nucleic acid molecule of claim 15, further comprising a 5' terminal extension of four or five guanine bases.

19. A vector comprising the isolated nucleic acid molecule of claim 1.

20. The vector of claim 19, wherein said vector is an Expression Vector.

21. A host cell comprising the isolated nucleic acid molecule of claim 1 or the vector of claim 19.

22. A method of synthesizing or amplifying one or more nucleic acid molecules comprising:

- (a) mixing one or more nucleic acid templates with at least one polypeptide having polymerase or reverse transcriptase activity and at least a first primer comprising a template-specific sequence that is complementary to or capable of hybridizing to said

templates and at least a second primer comprising all or a portion of a recombination site wherein said at least a portion of said second primer is homologous to or complementary to at least a portion of said first primer; and

- 5 (b) incubating said mixture under conditions sufficient to synthesize or amplify one or more nucleic acid molecules complementary to all or a portion of said templates and comprising one or more recombination sites or portions thereof at one or both termini of said molecules.

10 23. A method of synthesizing or amplifying one or more nucleic acid molecules comprising:

- 15 (a) mixing one or more nucleic acid templates with at least one polypeptide having polymerase or reverse transcriptase activity and at least a first primer comprising a template-specific sequence that is complementary to or capable of hybridizing to said templates and at least a portion of a recombination site, and at least a second primer comprising all or a portion of a recombination site wherein said at least a portion of said recombination site on said second primer is complementary to or homologous to at least a portion of said recombination site on said first primer; and

- 20 (b) incubating said mixture under conditions sufficient to synthesize or amplify one or more nucleic acid molecules complementary to all or a portion of said templates and comprising one or more recombination sites or portions thereof at one or both termini of said molecules.

25 24. A method of amplifying or synthesizing one or more nucleic acid molecules comprising:

- 30 (a) mixing one or more nucleic acid templates with at least one polypeptide having polymerase or reverse transcriptase activity

and one or more first primers comprising at least a portion of a recombination site and a template-specific sequence that is complementary to or capable of hybridizing to said template;

- 5 (b) incubating said mixture under conditions sufficient to synthesize or amplify one or more first nucleic acid molecules complementary to all or a portion of said templates wherein said molecules comprise at least a portion of a recombination site at one or both termini of said molecules;
- 10 (c) mixing said molecules with one or more second primers comprising one or more recombination sites, wherein said recombination sites of said second primers are homologous to or complementary to at least a portion of said recombination sites on said first nucleic acid molecules; and
- 15 (d) incubating said mixture under conditions sufficient to synthesize or amplify one or more second nucleic acid molecules complementary to all or a portion of said first nucleic acid molecules and which comprise one or more recombination sites at one or both termini of said molecules.

20 25. A polypeptide encoded by the isolated nucleic acid molecule of any one of claims 1-10.

25 26. An isolated nucleic acid molecule comprising one or more *att* recombination sites comprising at least one mutation in its core region that increases the specificity of interaction between said recombination site and a second *att* recombination site.

30 27. The isolated nucleic acid molecule of claim 26, wherein said mutation is at least one substitution mutation of at least one nucleotide in the seven basepair overlap region of said core region of said recombination site.

28. The isolated nucleic acid molecule of claim 26, wherein said nucleic acid molecule comprises the sequence NNNATAC, wherein "N" refers to any nucleotide with the proviso that if one of the first three nucleotides in the consensus sequence is a T/U, then at least one of the other two of the first three nucleotides is not a T/U.

29. An isolated nucleic acid molecule comprising one or more mutated *att* recombination sites comprising at least one mutation in its core region that enhances the efficiency of recombination between a first nucleic acid molecule comprising said mutated *att* recombination site and a second nucleic acid molecule comprising a second recombination site that interacts with said mutated *att* recombination site.

30. The isolated nucleic acid molecule of claim 29, wherein said mutated *att* recombination site is a mutated *attL* site comprising a core region having the nucleotide sequence caactnntnnnannaagttg, wherein "n" represents any nucleotide.

31. The isolated nucleic acid molecule of claim 30, wherein said mutated *attL* recombination site comprises a core region having a nucleotide sequence selected from agcctgctttattataactaagttggcatta (*attL5*) and agcctgctttttatattaagttggcatta (*attL6*).

32. The isolated nucleic acid molecule of claim 29, wherein said mutated *att* recombination site comprises a core region having a nucleotide sequence selected from the group consisting of ggggacaactttgtacaaaaagttggct (*attB1.6*), ggggacaactttgtacaagaaagctgggt (*attB2.2*), and ggggacaactttgtacaagaaagttgggt (*attB2.10*).

33. A vector selected from the group consisting of pENTR1A, pENTR2B, pENTR3C, pENTR4, pENTR5, pENTR6, pENTR7, pENTR8, pENTR9, pENTR10, pENTR11, pDEST1, pDEST2, pDEST3, pDEST4,

pDEST5, pDEST6, pDEST7, pDEST8, pDEST9, pDEST10, pDEST11, pDEST12.2 (also known as pDEST12), pDEST13, pDEST14, pDEST15, pDEST16, pDEST17, pDEST18, pDEST19, pDEST20, pDEST21, pDEST22, pDEST23, pDEST24, pDEST25, pDEST26, pDEST27, pDEST28, pDEST29, pDEST30, pDEST31, pDEST32, pDEST33, pDEST34, pDONR201 (also known as pENTR21 attP vector or pAttPkan Donor Vector), pDONR202, pDONR203 (also known as pEZ15812), pDONR204, pDONR205, pDONR206 (also known as pENTR22 attP vector or pAttPgen Donor Vector), pDONR207, pMAB58, pMAB62, pMAB85 and pMAB86.

34. A host cell comprising the vector of claim 33.

35. A polypeptide encoded by the vector of claim 33.

36. A kit for use in synthesizing a nucleic acid molecule, said kit comprising the isolated nucleic acid molecule of any one of claims 1-10, 26 and 29.

37. A kit for use in synthesizing a nucleic acid molecule, said kit comprising the primer of claim 15 or claim 18.

38. A kit for use in cloning a nucleic acid molecule, said kit comprising the vector of claim 19 or claim 33.

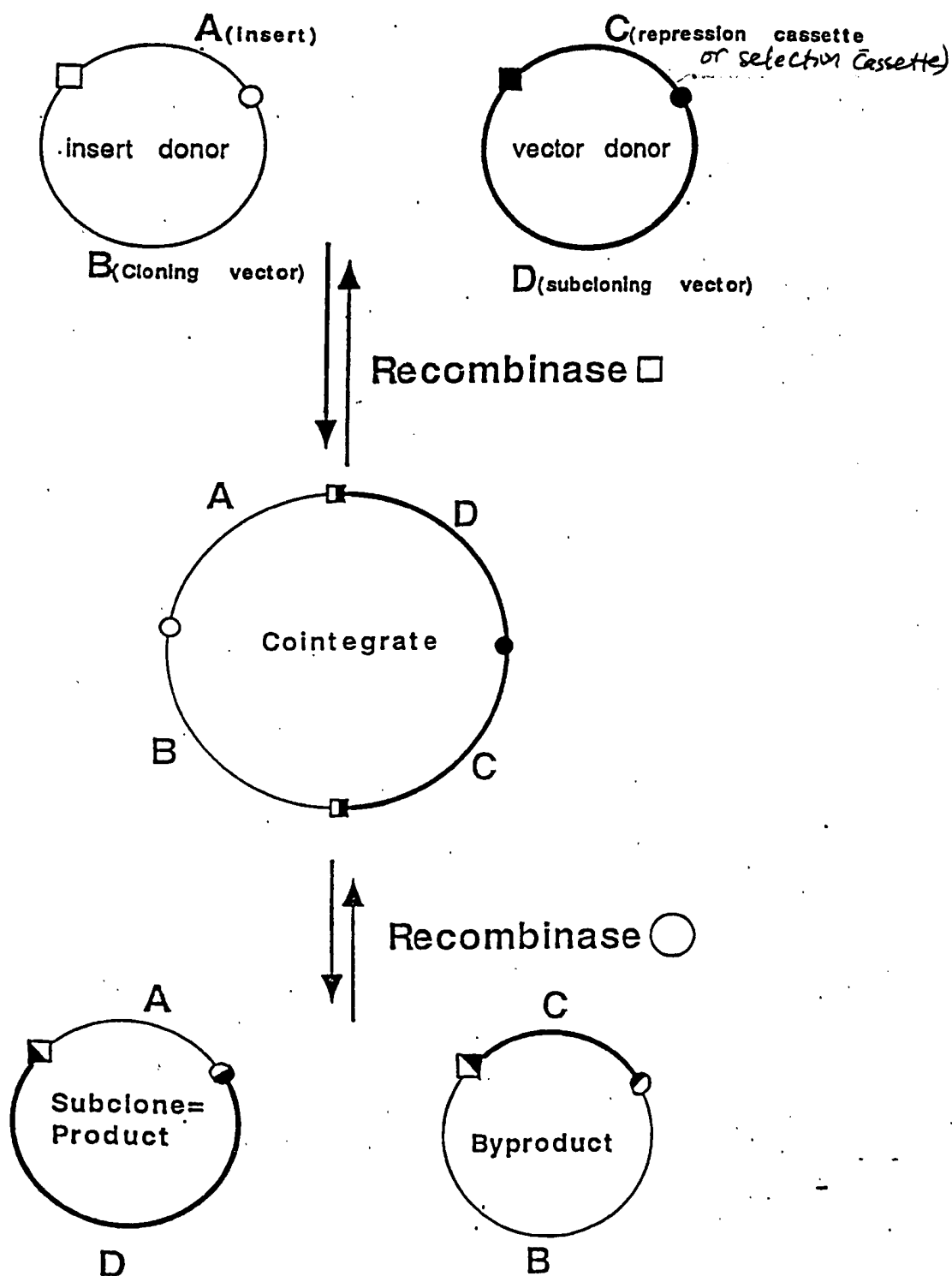


Figure 1

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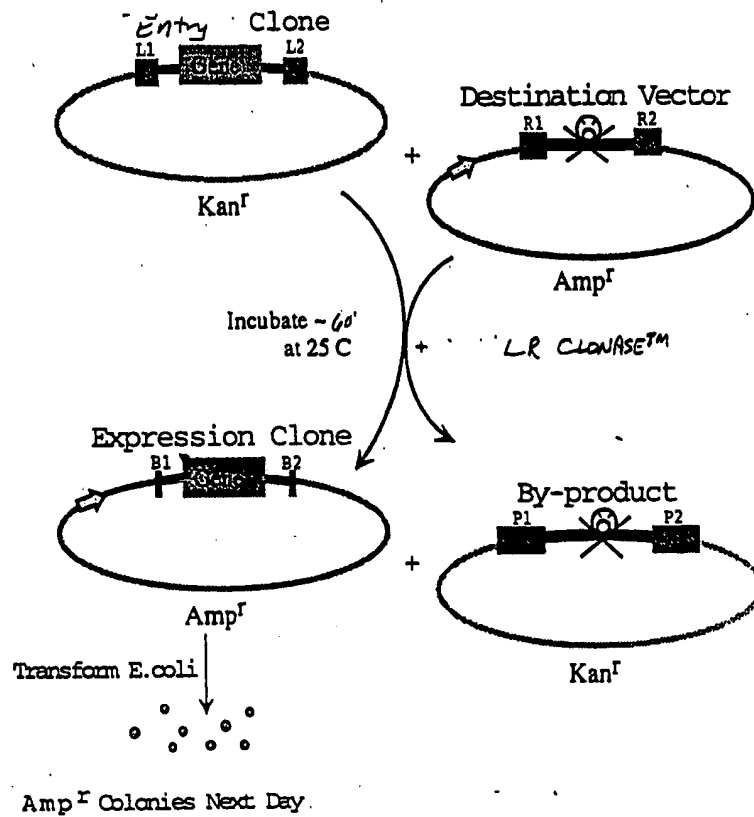


FIGURE 2

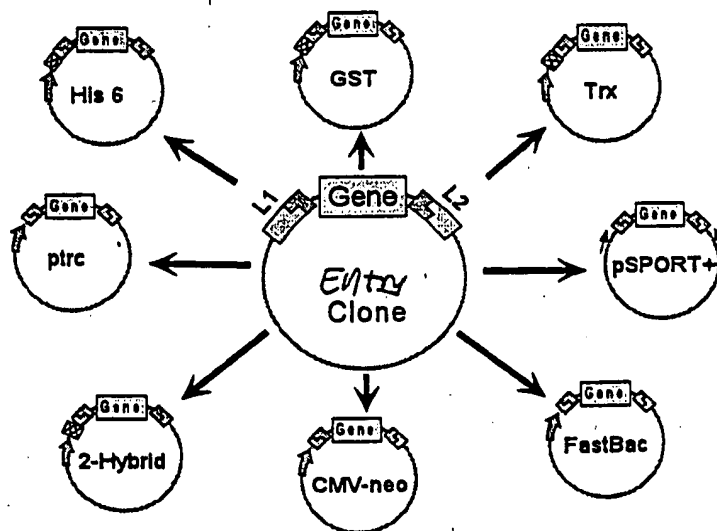


FIGURE 3

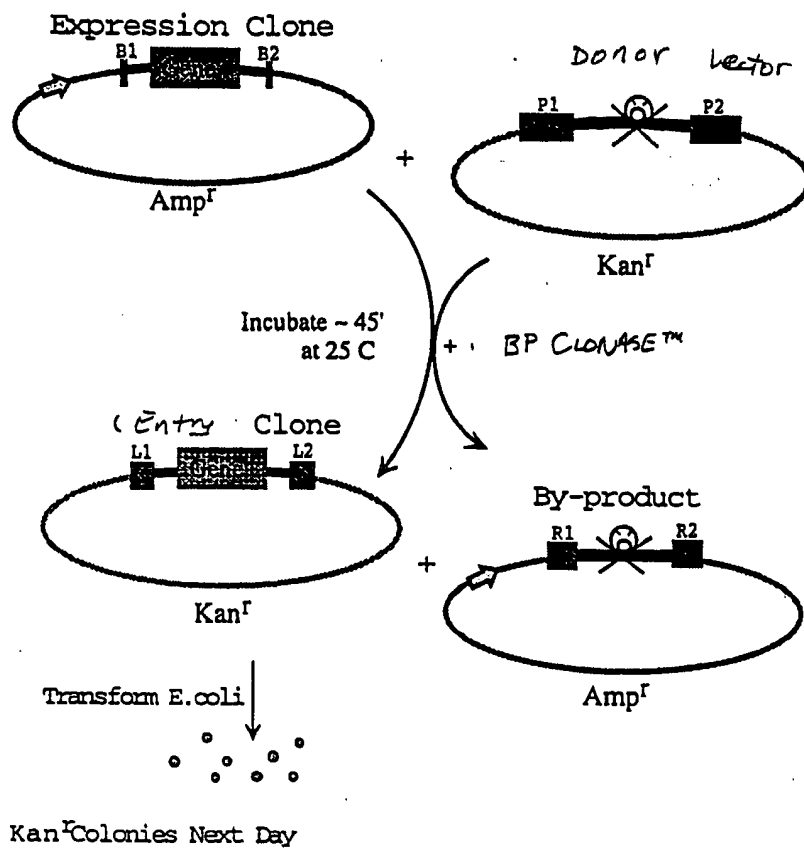


FIGURE 4

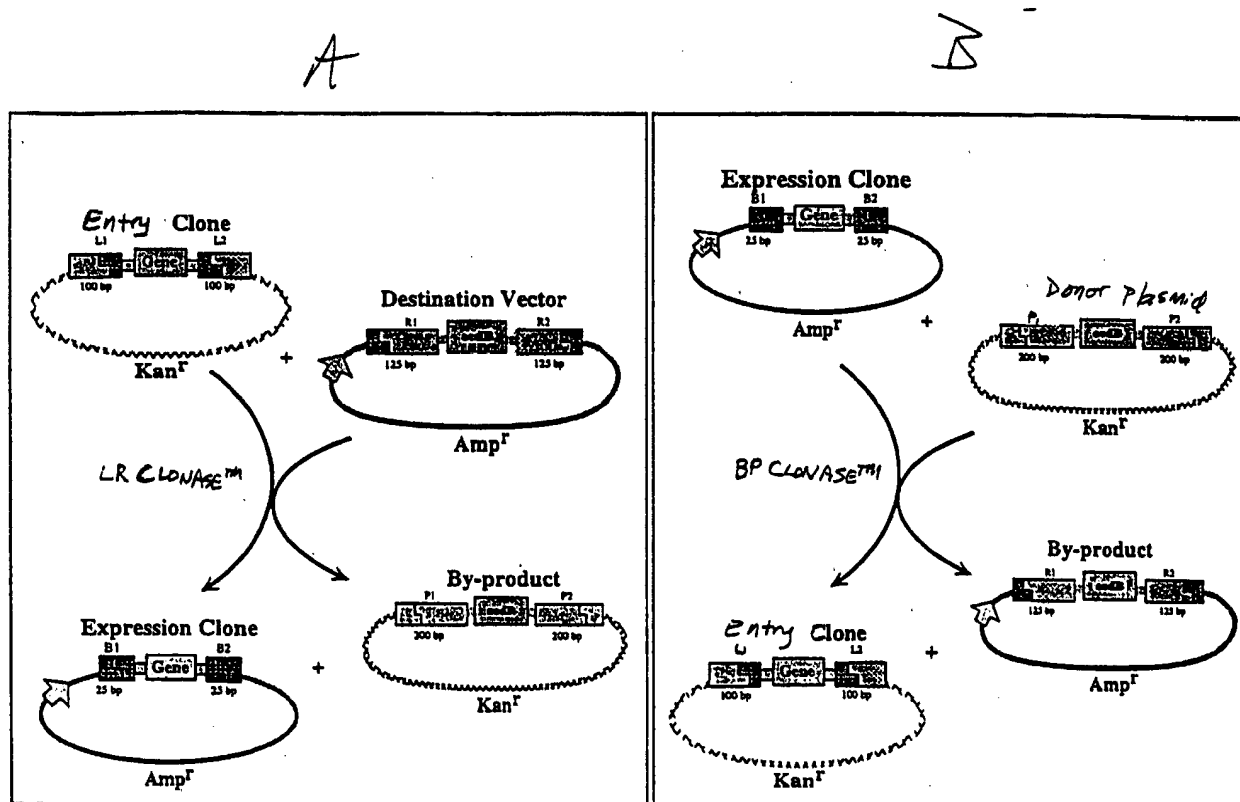


FIGURE 5

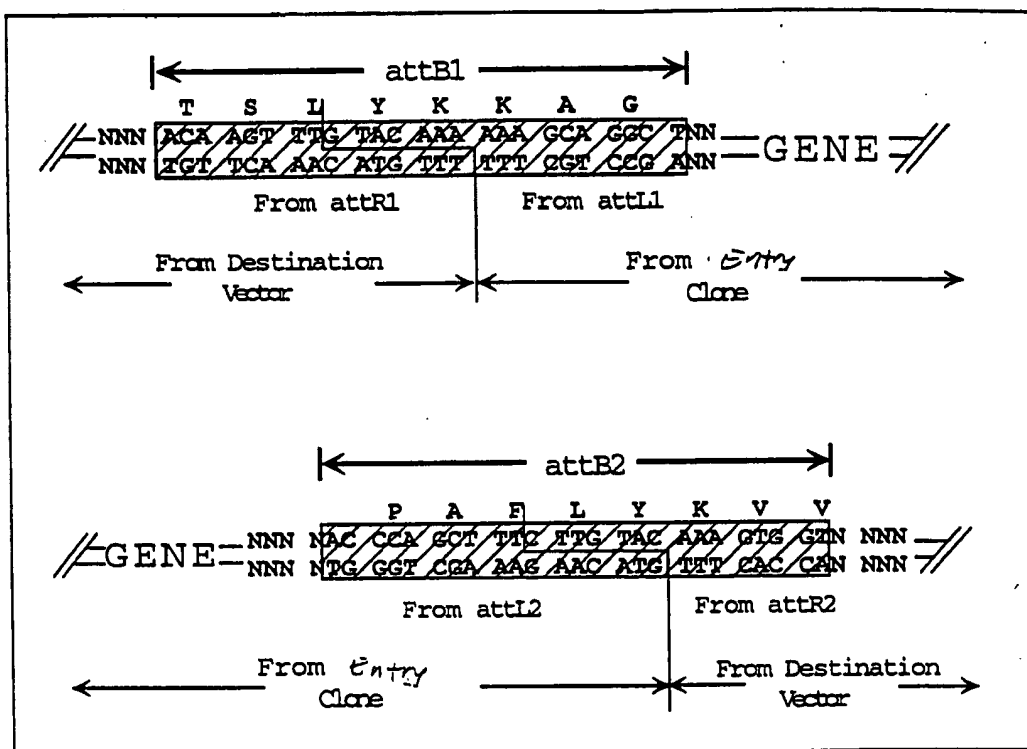


FIGURE 6

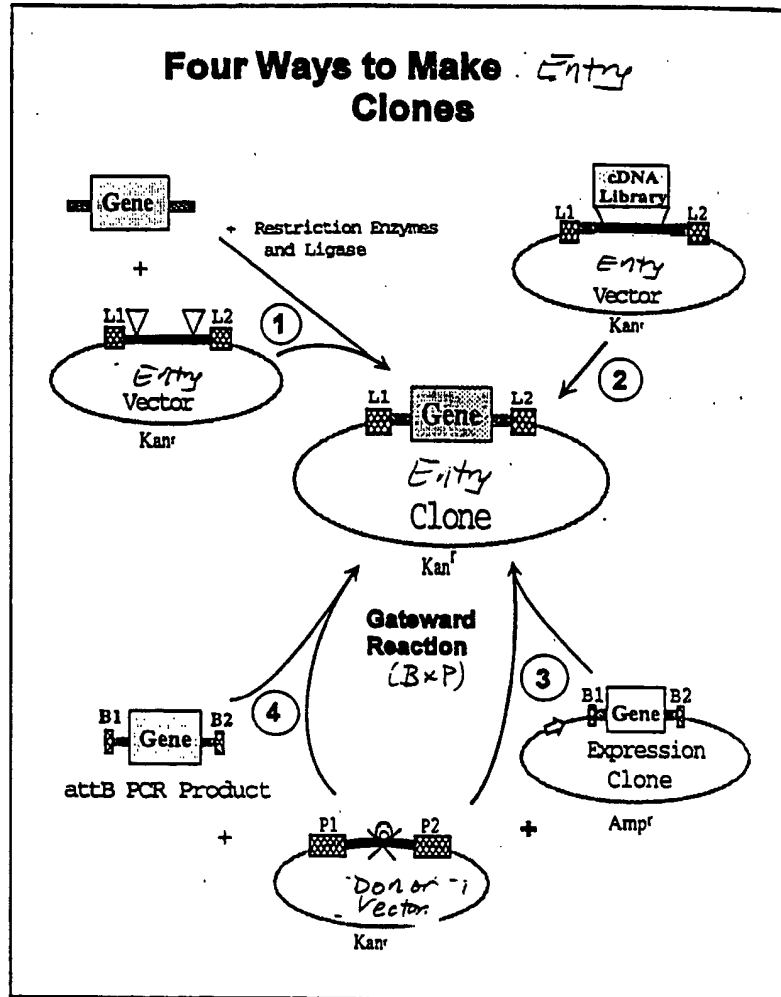


FIGURE 7

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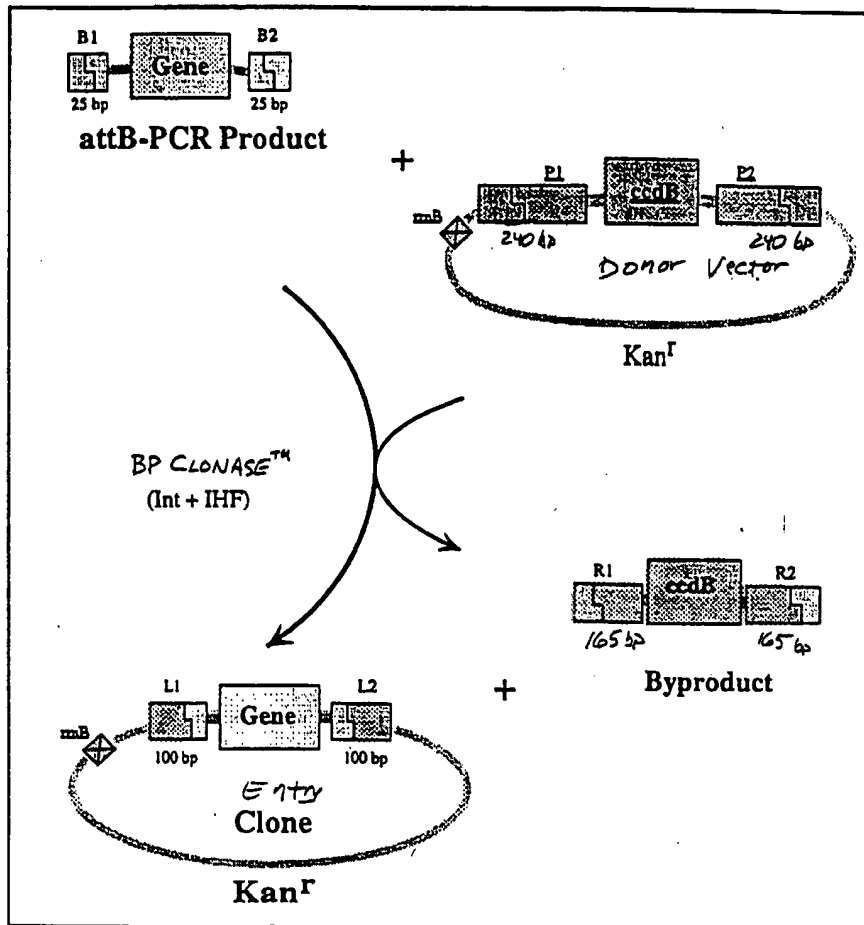


FIGURE 8

Recombination Site Nucleotide Sequences

attB1: 5'-ACAAGTTTGTACAAAAAAGCAGGCT-3'

attB2: 5'-ACCCAGCTTCTTGTACAAAGTGGT-3'

attP1: 5'-TACAGGTCACTAATACCATCTAAGTAGTTGATTCATAGTGAAGTGGATATG-
TTGTGTTTTACAGTATTATGTAGTCTGTTTTTATGCAAAATCTAATTTA-
ATATATTGATATTTATATCATTTTACGTTTCTCGTTCAGCTTTTTTGTAC-
AAAGTTGGCATTATAAAAAAGCATTGCTCATCAATTTGTTGCAACGAACA-
GGTCACTATCAGTCAAAATAAAATCATTATTTG-3'

attP2: 5'-CAAATAATGATTTTATTTTGAAGTGAAGTGAAGTGAAGTGAAGTGAAGT-
TGATAAGCAATGCTTTCTTATAATGCCAACTTTGTACAAGAAAGCTGAAC-
GAGAAACGTAAAATGATATAAATATCAATATATTAAATTAGATTTTGCAT-
AAAAACAGACTACATAATACTGTAAAACACAACATATCCAGTCACTATGA-
ATCAACTACTTAGATGGTATTAGTGACCTGTA-3'

attR1: 5'-ACAAGTTTGTACAAAAAAGCTGAACGAGAAACGTAAAATGATATAAA-
TATCAATATATTAAATTAGATTTTGCATAAAAAACAGACTACATAATAC-
TGTAACACAACATATCCAGTCACTATG-3'

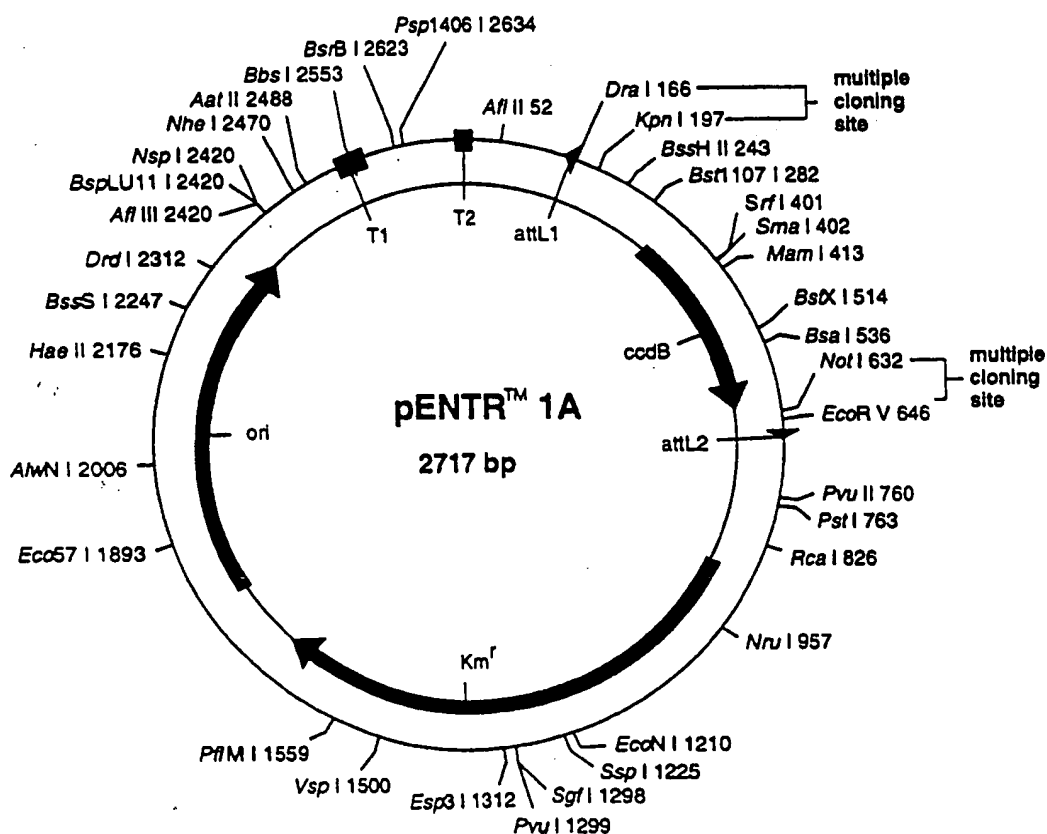
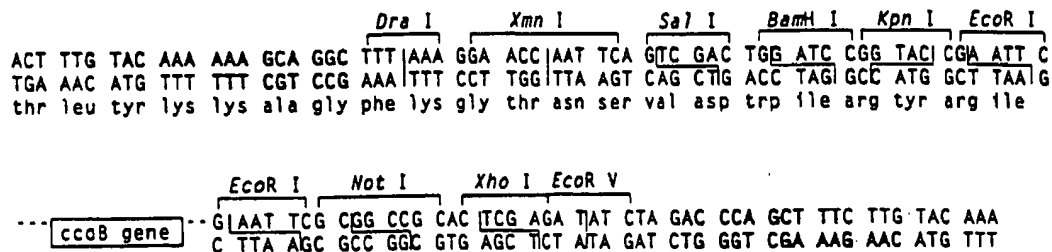
attR2: 5'-GCAGGTCGACCATAGTGAAGTGAAGTGAAGTGAAGTGAAGTGAAGT-
GTAGTCTGTTTTTTATGCAAAATCTAATTTAATATATTGATATTT-
ATATCATTTTACGTTTCTCGTTCAGCTTTCTTGTACAAAGTGGT-3'

attL1: 5'-CAAATAATGATTTTATTTTGAAGTGAAGTGAAGTGAAGTGAAGTGAAGT-
AAATTGATAAGCAATGCTTTTTTATAATGCCAACTTTGTACAAAAAA-
GCAGGCT-3'

attL2: 5'-CAAATAATGATTTTATTTTGAAGTGAAGTGAAGTGAAGTGAAGTGAAGT-
ATTGATAAGCAATGCTTTCTTATAATGCCAACTTTGTACAAGAAAGCTGGGT-3'

Figure 9

Figure 10A: Cloning sites of the Entry Vector pENTRTM 1A (reading frame A)



pENTR1A 2717 bp

<u>Base Nos.</u>	<u>Gene Encoded</u>
67..166	attL1
321..626	ccdB
655..754	attL2
877..1686	KmR
1791..2364	ori

```

1 CTGACGGATG GCCTTTTTC GTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC
61 GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT
121 AAGCAATGCT TTTTATAAT GCCAACTTTG TACAAAAAAG CAGGCTTTAA AGGAACCAAT
181 TCAGTCGACT GGATCCGGTA CCGAATTTCG TACTAAAAG CCAGATAACA GTATGCGTAT
241 TTGCGCGCTG ATTTTTCGGG TATAAGAATA TACTGATA TGTATACCCG AAGTATGTCA
301 AAAAGAGGTG TGCTTCTAGA ATGCAGTTTA AGGTTTACAC CTATAAAAAG GAGAGCCGTT
361 ATCGTCTGTT TGTGGATGTA CAGAGTGATA TTATTGACAC GCGCGGGCGA CGGATAGTGA
421 TCCCCCTGGC CAGTGCACGT CTGCTGTCAG ATAAAGTCTC CCGTGAACCT TACCCGGTGG
481 TGCATATCGG GGATGAAAGC TGGCGCATGA TGACCACCGA TATGGCCAGT GTGCCGGTCT
541 CCGTTATCGG GGAAGAAGTG GCTGATCTCA GCCACCGCGA AAATGACATC AAAAACGCCA
601 TTAACCTGAT GTTCTGGGGA ATATAGAATT CGCGGCCGCA CTCGAGATAT CTAGACCCAG
661 CTTTCTTGTA CAAAGTTGGC ATTATAAGAA AGCATTGCTT ATCAATTTGT TGCAACGAAC
721 AGGTCACAT CAGTCAAAAT AAAATCATT TTTGCCATCC AGCTGCAGCT CTGGCCCGTG
781 TCTCAAAATC TCTGATGTTA CATTGCACAA GATAAAAATA TATCATCATC ACAAATAAAA
841 CTGTCTGCTT ACATAAACAG TAATACAAGG GGTGTTATGA GCCATATTCA ACGGGAACG
901 TCGAGGCCGC GATTAAATTC CAACATGGAT GCTGATTTAT ATGGGTATAA ATGGGCTCGC
961 GATAATGTCG GGCAATCAGG TCGACAATC TATCGCTTGT ATGGGAAGCC CGATGCGCCA
1021 GAGTTGTTTC TGAAACATGG CAAAGGTAGC GTTGCCAATG ATGTTACAGA TGAGATGGTC
1081 AGACTAAACT GGCTGACGGA ATTTATGCCT CTTCCGACCA TCAAGCATT TATCCGTACT
1141 CCTGATGATG CATGGTTACT CACCACTGCG ATCCCCGGAA AAACAGCATT CCAGGTATTA
1201 GAAGAATATC CTGATTCAGG TGAAAATATT GTTGATGCGC TGGCAGTGTC CCTGCGCCGG
1261 TTGCATTCGA TTCCTGTTTG TAATTGTCCT TTTAACAGCG ATCGCGTATT TCGTCTCGCT
1321 CAGGCGCAAT CACGAATGAA TAACGGTTTG GTTGATGCGA GTGATTTTGA TGACGAGCGT
1381 AATGGCTGGC CTGTTGAACA AGTCTGAAA GAAATGCATA AACTTTTGCC ATTCTCACCG
1441 GATTCACTCG TCACTCATGG TGATTTCTCA CTTGATAACC TTATTTTGA CGAGGGGAAA
1501 TTAATAGGTT GTATGATGT TGGACGAGTC GGAATCGCAG ACCGATACCA GGATCTTGCC
1561 ATCCTATGGA ACTGCCTCGG TGAGTTTTCT CTTTCATTAC AGAAACGGCT TTTTCAAAA
1621 TATGGTATTG ATAATCCTGA TATGAATAAA TTGCAGTTTC ATTTGATGCT CGATGAGTTT
1681 TTCTAATCAG AATTGGTTAA TTGGTTGTAA CATTATTCAG ATTGGGCCCC GTTCCACTGA
1741 GCGTCAGACC CCGTAGAAAA GATCAAAGGA TCTTCTTGAG ATCCTTTTTT TCTGCGCGTA
1801 ATCTGCTGCT TGCAAAACAA AAAACCACCG CTACCAGCGG TGGTTTGTGTT GCCGGATCAA
1861 GAGCTACCAA CTCTTTTTC GAAGGTAAC TGGCTTCAGCA GAGCGCAGAT ACCAAATACT
1921 GTTCTTCTAG TGTAGCCGTA GTTAGGCCAC CACTTCAAGA ACTCTGTAGC ACCGCCTACA
1981 TACCTCGCTC TGCTAATCCT GTTACCAGTG GCTGCTGCCA GTGGCGATAA GTCGTGTCTT
2041 ACCGGGTTGG ACTCAAGACG ATAGTTACCG GATAAGGCGC AGCGGTCGGG CTGAACGGGG
2101 GGTTCTGTGA CACAGCCCAG CTTGGAGCGA ACGACCTACA CCGAACTGAG ATACCTACAG
2161 CGTGAGCTAT GAGAAAGCGC CACGCTTCCC GAAGGGAGAA AGGCGGACAG GTATCCGGTA
2221 AGCGGCAGGG TCGGAACAGG AGAGCGCACG AGGGAGCTTC CAGGGGGAAA CGCCTGGTAT
2281 CTTTATAGTC CTGTGGGTT TCGCCACCTC TGACTTGAGC GTCGATTTT GTGATGCTCG
2341 TCAGGGGGGC GGAGCCTATG GAAAAACGCC AGCAACGCGG CCTTTTTACG GTTCCTGGCC
2401 TTTTGCTGGC CTTTGTCTCA CATGTTCTTT CCTGCGTTAT CCCCTGATTC TGTGGATAAC
2461 CGTATTACCG CTAGCATGGA TCTCGGGGAC GTCTAACTAC TAAGCGAGAG TAGGGAACTG
2521 CCAGGCATCA AATAAACGA AAGGCTCAGT CGGAAGACTG GGCCTTTCGT TTTATCTGTT
2581 GTTTGTGGGT GAACGCTCTC CTGAGTAGGA CAAATCCGCC GGGAGCGGAT TTGAACGTTG
2641 TGAAGCAACG GCCCGGAGGG TGGCGGGCAG GACGCCCGCC ATAAACTGCC AGGCATCAAA
2701 CTAAGCAGAA GGCCATC

```

FIGURE 10B

Figure 11A: Cloning Sites of the Entry Vector pENTR2B (reading frame-B)

Int	attL1	EheI	XmnI	SalI	BamHI
TTG	TAC AAA AAA GCA GGC	TGG CGC CGG AAC CAA	TTC AGT CGA CTG	GAT CCG	
AAC	ATG TTT TTT CGT CCG	ACC GCG GCC TTG GTT	AAG TCA GCT GAC	CTA GGC	
Leu	Tyr Lys Lys Ala Gly Trp	Arg Arg Asn Gln Phe	Ser Arg	Leu Asp	Pro

KpnI	EcoRI	EcoRI	NotI	XhoI	EcoRV	XbaI
GTA GCG AAT TC- ccdB	--G AAT TCG CGG CCG CAC	TCG AGA TAT CTA GAC CCA				
CAT GGC TTA AG	C TTA AGC GCC GGC GTG	AGC TCT ATA GAT CTG GGT				
Val Pro Asn	Asn Ser Arg Pro	His Ser Arg Tyr	Leu Asp	Pro		

Int	attL2
GCT TTC TTG TAC AAA G	
CGA AAG AAC ATG TTT C	
Ala Phe Leu Tyr Lys	

pENTR2B 2718 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
322..627		ccdB
656..755		attL2
878..1687		KmR
1792..2365		ori
1	CTGACGGATG GCCTTTTTTC GTTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC	
61	GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT	
121	AAGCAATGCT TTTTATAAT GCCAACTTTG TACAAAAAAG CAGGCTGGCG CCGGAACCAA	
181	TTTCAGTCGAC TGGATCCGGT ACCGAATTCG CTTACTAAAA GCCAGATAAC AGTATGCGTA	
241	TTTGCGCGCT GATTTTTGCG GTATAAGAAT ATATACTGAT ATGTATACCC GAAGTATGTC	
301	AAAAAGAGGT GTGCTTCTAG AATGCAGTTT AAGGTTTACA CTTATAAAAG AGAGAGCCGT	
361	TATCGTCTGT TTGTGGATGT ACAGAGTGAT ATTATTGACA CGCCCGGGCG ACGGATGGTG	
421	ATCCCCCTGG CCAGTGCACG TCTGCTGTCA GATAAAGTCT CCCGTGAAC TACCCGGTG	
481	GTGCATATCG GGGATGAAAG CTGGCGCATG ATGACCACCG ATATGCCAG TGTGCCGGTC	
541	TCCGTTATCG GGAAGAAGT GGCTGATCTC AGCCACCGCG AAAATGACAT CAAAACGCC	
601	ATTAACCTGA TGTCTGCGG AATATAGAAT TCGCGGCGC ACTCGAGATA TCTAGACCCA	
661	GCTTTCTTGT ACAAAGTTGG CATTATAAGA AAGCATTGCT TATCAATTTG TTGCAACGAA	
721	CAGGTCAC TAAGTCAAAA TAAAATCATT ATTTGCCATC CAGCTGCAGC TCTGGCCCGT	
781	GTCTCAAAAT CTCTGATGTT ACATTGCACA AGATAAAAT ATATCATCAT GAACAATAAA	
841	ACTGTCTGCT TACATAACA GTAATACAAG GGGTGTATG AGCCATATTC AACGGGAAAC	
901	GTCGAGGCCG CGATTAAAT CCAACATGGA TGCTGATTTA TATGGGTATA AATGGGCTCG	
961	CGATAATGTC GGGCAATCAG GTGCGACAAT CTATCGCTTG TATGGGAAGC CCGATGCGCC	
1021	AGAGTTGTTT CTGAAACATG GCAAAGGTAG CGTTGCCAAT GATGTTACAG ATGAGATGGT	
1081	CAGACTAAAC TGGCTGACGG AATTTATGCC TCTTCGACC ATCAAGCATT TTATCCGTAC	
1141	TCCTGATGAT GCATGGTTAC TCACCACTGC GATCCCCGGA AAAACAGCAT TCCAGGTATT	
1201	AGAAGAATAT CCTGATTCAG GTGAAAATAT TGTGTATGCG CTGGCAGTGT TCCTGCGCCG	
1261	GTTGCATTTC ATTCTGTTT GTAATTGTCC TTTTAACAGC GATCGCGTAT TTCGTCTCGC	
1321	TCAGGCGCAA TCACGAATGA ATAACGGTTT GGTGTATGCG AGTGATTTTG ATGACGAGCG	
1381	TAATGGCTGG CCTGTTGAAC AAGTCTGGAA AGAAATGCAT AAATTTTGC CATTCTCACC	
1441	GGATTCAGTC GTCATCATG GTGATTTCTC ACTTGATAAC CTTATTTTGT ACGAGGGGAA	
1501	ATTAATAGGT TGTATTGATG TTGGACGAGT CGGAATCGCA GACCGATACC AGGATCTTGC	
1561	CATCCTATGG AACTGCCTCG GTGAGTTTTT TCCTTCATTA CAGAAACGGC TTTTCAAAA	
1621	ATATGGTATT GATAATCCTG ATATGAATAA ATTGCAGTTT CATTTGATGC TCGATGAGTT	
1681	TTTCTAATCA GAATTGGTTA ATTGGTTGTA ACATTATTCA GATTGGGCCC CGTTCCACTG	
1741	AGCGTCAGAC CCCGTAGAAA AGATCAAAGG ATCTTCTTGA GATCCTTTT TTCTGCGCGT	
1801	AATCTGCTGC TTGCAACAA AAAAACCACC GCTACCAGCG GTGGTTTGTT TGCCGGATCA	
1861	AGAGCTACCA ACTCTTTTTC CGAAGGTAAC TGGCTTCAGC AGAGCGCAGA TACCAAATAC	
1921	TGTTCTTCTA GTGTAGCCGT AGTTAGGCCA CCACTTCAAG AACTCTGTAG CACCGCCTAC	
1981	ATACCTCGCT CTGCTAATCC TGTTACCAGT GGCTGCTGCC AGTGGCGATA AGTCGTGTCT	
2041	TACCGGGTTG GACTCAAGAC GATAGTTACC GGATAAGGCG CAGCGGTCGG GCTGAACGGG	
2101	GGGTTTCGTG ACACAGCCCA GCTTGGAGCG AACGACCTAC ACCGAACTGA GATACCTACA	
2161	GCGTAGCTA TGAGAAAGCG CCACGCTTCC CGAAGGGAGA AAGGCGGACA GGTATCCGGT	
2221	AAGCGGACAG GTCGGAACAG GAGAGCGCAC GAGGGAGCTT CCAGGGGGA ACGCCTGGTA	
2281	TCTTTATAGT CCGTTCGGGT TTCGCCACCT CTGACTTGAG CGTCGATTTT TGTGATGCTC	
2341	GTCAGGGGGG CGGAGCCTAT GGAAAAACGC CAGCAACGCG GCCTTTTAC GGTTCCTGGC	
2401	CTTTTGCTGG CCTTTTGCTC ACATGTTCTT TCCTGCGTTA TCCCCTGATT CTGTGGATAA	
2461	CCGTATTACC GCTAGCATGG ATCTCGGGGA CGTCTAACTA CTAAGCGAGA GTAGGGAAC	
2521	GCCAGGCATC AAATAAAACG AAAGGCTCAG TCGGAAGACT GGGCCTTTCG TTTTATCTGT	
2581	TGTTTGTGCG TGAACGCTCT CCTGAGTAGG ACAAATCCGC CGGGAGCGGA TTTGAACGTT	
2641	GTGAAGCAAC GGCCCGGAGG GTGGCGGGCA GGACGCCCGC CATAAATGTC CAGGCATCAA	
2701	ACTAAGCAGA AGGCCATC	

FIGURE 11B

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Figure 12A: Cloning Sites of the Entry Vector pENTR3C (reading frame C)

Int	attL1		DraI		XmnI		SalI		BamHI								
TTG	TAC	AAA	AAA	GCA	GGC	TCT	TTA	AAG	GAA	COA	ATT	CAG	TCG	ACT	GGA	TCC	GGT
AAC	ATG	TTT	TTT	CGT	CCG	AGA	AAT	TTC	CTT	GGT	TAA	GTC	AGC	TGA	CCT	AGG	CCA
							↓			↓				↓		↓	↓
Leu	Tyr	Lys	Lys	Ala	Gly	Ser	Leu	Lys	Glu	Pro	Ile	Gln	Ser	Thr	Gly	Ser	Gly

KpnI	EcoRI		PvuI		EcoRI		NotI		XhoI		EcoRV	XbaI			
ACC	GAA	TTC	GAT	CGC--	ccdB	--G	AAT	TCG	CGG	CCG	CAC	TCG	AGA	TAT	CTA
TGG	CTT	AAG	CTA	GCG		C	TTA	AGC	GCC	GGC	GTG	AGC	TCT	ATA	GAT
			↓					↓				↓		↓	
Thr	Glu	Phe					Asn	Ser	Arg	Pro	His	Ser	Arg	Tyr	Leu

attL2		Int					
GAC	CCA	GCT	TTC	TTG	TAC	AAA	G
CTG	GGT	CGA	AAG	AAC	ATG	TTT	C
			↓				
Asp	Pro	Ala	Phe	Leu	Tyr	Lys	

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pENTR3C 2723 bp

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
67..166	attL1
327..632	ccdB
661..760	attL2
883..1692	KmR
1797..2370	ori

```

1 CTGACGGATG GCCTTTTTCG GTTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC
61 GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT
121 AAGCAATGCT TTTTATAAAT GCCAACTTTG TACAAAAAAG CAGGCTCTTT AAAGGAACCA
181 ATTCAGTCGA CTGGATCCGG TACCGAATTC GATCGCTTAC TAAAAGCCAG ATAACAGTAT
241 GCGTATTTGC GCGCTGATTT TTGCGGTATA AGAATATATA CTGATATGTA TACCCGAAGT
301 ATGTCAAAAA GAGGTGTGCT TCTAGAATGC AGTTTAAGGT TTACACCTAT AAAAGAGAGA
361 GCCGTTATCG TCTGTTGTG GATGTACAGA GTGATATTAT TGACACGCCC GGGCGACGGA
421 TGGTGATCCC CCTGCCAGT GCACGTCTGC TGTCAGATAA AGTCTCCCGT GAACTTTACC
481 CGGTGGTGCA TATCGGGGAT GAAAGCTGGC GCATGATGAC CACCGATATG GCCAGTGTGC
541 CGGTCTCCGT TATCGGGGAA GAAGTGGCTG ATCTCAGCCA CCGCGAAAAA GACATCAAAA
601 ACGCCATTAA CCTGATGTTT TGGGGAATAT AGAATTCGCG GCCGCACTCG AGATATCTAG
661 ACCCAGCTTT CTTGTACAAA GTTGGCATT AAGAAAAGCA TTGCTTATCA ATTTGTTGCA
721 ACGAACAGGT CACTATCAGT CAAAATAAAA TCATTATTTG CCATCCAGCT GCAGCTCTGG
781 CCCGTGTCTC AAAATCTCTG ATGTTACATT GCACAAGATA AAAATATATC ATCATGAACA
841 ATAAACTGT CTGCTTACAT AAACAGTAAT ACAAGGGGTG TTATGAGCCA TATTCAACGG
901 GAAACGTCGA GGCCGCGATT AAATCCAAC ATGGATGCTG ATTTATATGG GTATAAATGG
961 GCTCGCGATA ATGTCGGGCA ATCAGGTGCG ACAATCTATC GCTTGATGGA GAAGCCCGAT
1021 GCGCCAGAGT TGTTTCTGAA ACATGGCAAA GGTAGCGTTG CCAATGATGT TACAGATGAG
1081 ATGGTCAGAC TAAACTGGCT GACGGAATTT ATGCCTCTTC CGACCATCAA GCATTTTATC
1141 CGTACTCCTG ATGATGCATG GTTACTCACC ACTGCGATCC CCGGAAAAAC AGCATTCCAG
1201 GTATTAGAAG AATATCCTGA TTCAGGTGAA AATATTGTTG ATGCGCTGGC AGTGTTCTCTG
1261 CGCCGGTTGC ATTCGATTCC TGTTTGTAAT TGTCCTTTTA ACAGCGATCG CGTATTTCTG
1321 CTCGCTCAGG CGCAATCACG AATGAATAAC GGTTTGGTTG ATGCGAGTGA TTTTGATGAC
1381 GAGCGTAATG GCTGGCCTGT TGAACAAGTC TGGAAAGAAA TGATAAACT TTTGCCATTG
1441 TCACCGGATT CAGTCGTCAC TCATGGTGAT TTCTCACTTG ATAACCTTAT TTTTGACGAG
1501 GGGAAATTAA TAGGTTGTAT TGATGTTGGA CGAGTCGGAA TCGCAGACCG ATACCAGGAT
1561 CTTGCCATCC TATGGAATG CCTCGGTGAG TTTTCTCCTT CATTACAGAA ACGGCTTTT
1621 CAAAAATATG GTATTGATAA TCCTGATATG AATAAAATGC AGTTTCATTG GATGCTCGAT
1681 GAGTTTTTCT AATCAGAAAT GGTTAATTGG TTGTAACATT ATTCAGATTG GGCCCCGTTG
1741 CACTGAGCGT CAGACCCCGT AGAAAAGATC AAAGGATCTT CTTGAGATCC TTTTCTCTG
1801 CGCGTAATCT GCTGCTTGCA AACAAAAAAA CCACCGCTAC CAGCGGTGGT TTGTTTGCCG
1861 GATCAAGAGC TACCAACTCT TTTTCCGAAG GTAAGTGGCT TCAGCAGAGC GCAGATACCA
1921 AATACTGTTC TTCTAGTGTA GCCGTAGTTA GGCCACCACT TCAAGAACTC TGTAGACCCG
1981 CCTACATACC TCGCTCTGCT AATCCTGTTA CCAGTGGCTG CTGCCAGTGG CGATAAGTCG
2041 TGTCTTACCG GGTGGAATC AAGACGATAG TTACCGGATA AGGCGCAGCG GTCGGGCTGA
2101 ACGGGGGGTT CGTGACACAC GCCCAGCTTG GAGCGAACGA CCTACACCGA ACTGAGATAC
2161 CTACAGCGTG AGCTATGAGA AAGCGCCACG CTTCCCGAAG GGAGAAAGGC GGACAGGTAT
2221 CCGGTAAGCG GCAGGGTCGG AACAGGAGAG CGCACGAGGG AGCTTCCAGG GGGAAACGCC
2281 TGGTATCTTT ATAGTCCTGT CGGGTTTCGC CACCTCTGAC TTGAGCGTCG ATTTTGTGTA
2341 TGCTCGTCAG GGGGGCGGAG CCTATGGAAA AACGCCAGCA ACGCGCCTT TTTACGGTTC
2401 CTGGCCTTTT GCTGGCCTTT TGCTCACATG TTCTTTCCTG CGTTATCCCC TGATTCTGTG
2461 GATAACCGTA TTACCGCTAG CATGGATCTC GGGGACGTCT AACTACTAAG CGAGAGTAGG
2521 GAAGTCCAG GCATCAAATA AAACGAAAGG CTCAGTCGGA AGACTGGGCC TTTTCGTTTA
2581 TCTGTTGTTT GTCGGTGAAC GCTCTCCTGA GTAGGACAAA TCCGCCGGGA GCGGATTGTA
2641 ACGTTGTGAA GCAACGGCCC GGAGGGTGCC GGGCAGGACG CCCGCCATAA ACTGCCAGGC
2701 ATCAAGTAA GCAGAAGGCC ATC

```

FIGURE 12B

Int attL1

NcoI Kozak XmnI SalI BamHI

TTC TAC AAA AAA GCA GGC TCC ACC ATG GGA ACC AAT TCA GTC GAC TGG ATC CGG
AAC ATG TTT TTT CGT CCG AGG TGG TAC CCT TGG TTA AGT CAG CTG ACC TAG GGC

Leu Tyr Lys Lys Ala Gly Ser Thr Met Gly Thr Asn Ser Val Asp Trp Ile Arg

KpnI EcoRI

EcoRI NotI XhoI EcoRV XbaI

TAC CGA ATT C-- ccdB --G AAT TCG CGG CCG CAC TCG AGA TAT CTA GAC CCA GCT
ATG GCT TAA G C TTA AGC GCC GGC GTG AGC TCT ATA GAT CTG GGT CGA

Tyr Arg Ile Asn Ser Arg Pro His Ser Arg Tyr Leu Asp Pro Ala

Int attL2

TTC TTG TAC AAA G
AAG AAC ATG TTT C

Phe Leu Tyr Lys

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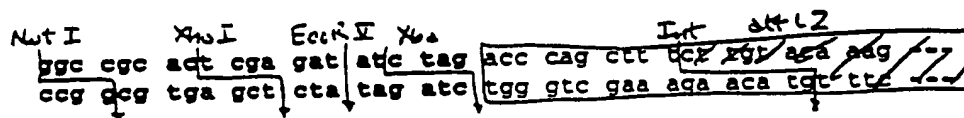
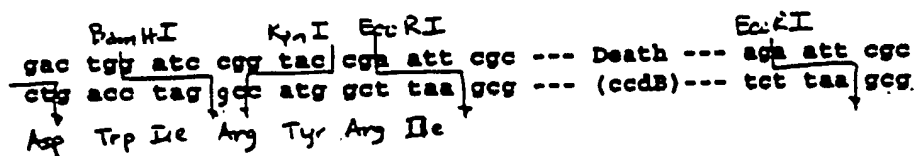
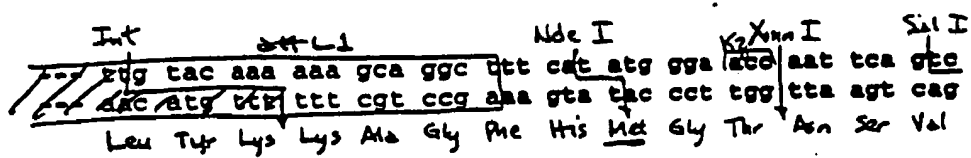
pENTR4 2720 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
324..629		ccdB
658..757		attL2
880..1689		KmR
1794..2367		ori
1	CTGACGGATG GCCTTTTTCG GTTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC	
61	GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT	
121	AAGCAATGCT TTTTATAAT GCCAACTTTG TACAAAAAAG CAGGCTCCAC CATGGGAACC	
181	AATTCAGTCG ACTGGATCCG GTACCGAATT CGCTTACTAA AAGCCAGATA ACAGTATGCG	
241	TATTTGCGCG CTGATTTTTC CGGTATAAGA ATATATACTG ATATGTATAC CCGAAGTATG	
301	TCAAAAAGAG GTGTGCTTCT AGAATGCAGT TTAAGGTTTA CACCTATAAA AGAGAGAGCC	
361	GTTATCGTCT GTTTGTGGAT GTACAGAGTG ATATTATTGA CACGCCCCGG CGACGGATGG	
421	TGATCCCCCT GGCCAGTGCA CGTCTGCTGT CAGATAAAGT CTCCCGTGAA CTTTACCCGG	
481	TGGTGACATAT CGGGGATGAA AGCTGGCGCA TGATGACCAC CGATATGGCC AGTGTGCCGG	
541	TCTCCGTTAT CGGGGAAGAA GTGGCTGATC TCAGCCACCG CGAAAATGAC ATCAAAAACG	
601	CCATTAACCT GATGTTCTGG GGAATATAGA ATTCGCGGCC GCACTCGAGA TATCTAGACC	
661	CAGCTTTCTT GTACAAAGTT GGCATTATAA GAAAGCATTG CTTATCAATT TGTGCAACG	
721	AACAGGTCAC TATCAGTCAA AATAAAATCA TTATTTGCCA TCCAGCTGCA GCTCTGGCCC	
781	GTGTCTCAAA ATCTCTGATG TTACATTGCA CAAGATAAAA ATATATCATC ATGAACAATA	
841	AACTGTCTCG CTTACATAAA CAGTAATACA AGGGGTGTTA TGAGCCATAT TCAACGGGAA	
901	ACGTCGAGGC CGCGATTAAT TTCCAACATG GATGCTGATT TATATGGGTA TAAATGGGCT	
961	CGCGATAATG TCGGGCAATC AGGTGCGACA ATCTATCGCT TGTATGGGAA GCCCGATGCG	
1021	CCAGAGTTGT TCTGAAACA TGGCAAAGGT AGCGTTGCCA ATGATGTTAC AGATGAGATG	
1081	GTCAGACTAA ACTGGCTGAC GGAATTTATG CCTCTTCCGA CCATCAAGCA TTTTATCCGT	
1141	ACTCCTGGTG ATGCATGGTT ACTCACCAC TCGATCCCCG GAAAAACAGC ATTCCAGGTA	
1201	TTAGAAGAAT ATCCTGATTC AGGTGAAAAT ATTGTTGATG CGCTGGCAGT GTTCCTGCGC	
1261	CGGTTGCATT CGATTCCTGT TTGTAATTGT CCTTTTAACA GCGATCGCGT ATTTCTGCTC	
1321	GCTCAGGCGC AATCACGAAT GAATAACGGT TTGGTTGATG CGAGTGATTT TGATGACGAG	
1381	CGTAATGGCT GGCCTGTTGA ACAAGTCTGG AAAGAAATGC ATAAACTTTT GCCATTCTCA	
1441	CCGGATTGAG TCGTCACTCA TGGTGATTTT TCACTTGATA ACCTTATTTT TGACGAGGGG	
1501	AAATTAAATG GTTGATTGTA TGTGGACGCA GTCGGAATCG CAGACCGATA CCAGGATCTT	
1561	GCCATCCTAT GGAAGTGCCT CGGTGAGTTT TCTCCTTCAT TACAGAAACG GCTTTTTCAA	
1621	AAATATGGTA TTGATAATCC TGATATGAAT AAATTGCAGT TTCATTTGAT GCTCGATGAG	
1681	TTTTTCTAAT CAGAATTGGT TAATTGGTTG TAACATTATT CAGATTGGGC CCCGTTCCAC	
1741	TGAGCGTCAG ACCCGTAGA AAAGATCAAA GGATCTTCTT GAGATCCTTT TTTTCTGCGC	
1801	GTAATCTGCT GCTTGCAAAC AAAAAAACCA CCGCTACCAG CGGTGGTTTG TTTGCCGGAT	
1861	CAAGAGCTAC CAACTCTTTT TCCGAAGGTA ACTGGCTTCA GCAGAGCGCA GATACCAAAT	
1921	ACTGTTCTTC TAGTGTAGCC GTAGTTAGGC CACCACTTCA AGAACTCTGT AGCACCGCCT	
1981	ACATACCTCG CTCTGCTAAT CCTGTTACCA GTGGCTGCTG CCAGTGGCGA TAAGTCGTGT	
2041	CTTACCGGGT TGGACTCAAG ACGATAGTTA CCGGATAAGG CGCAGCGGTC GGGCTGAACG	
2101	GGGGGTTTCG GCACACAGCC CAGCTTGGAG CGAACGACCT ACACCGAACT GAGATACCTA	
2161	CAGCGTGAGC TATGAGAAAG CGCCACGCTT CCCGAAGGGA GAAAGGCGGA CAGGTATCCG	
2221	GTAAGCGGCA GGGTCGGAAC AGGAGAGCGC ACGAGGGAGC TTCCAGGGGG AAACGCCTGG	
2281	TATCTTTATA GTCCTGTGCG GTTTCGCCAC CTCTGACTTG AGCGTCGATT TTTGTGATGC	
2341	TCGTACAGGG GCGGAGCCT ATGGAAAAAC GCCAGCAACG CGGCCTTTTT ACGGTTCTCT	
2401	GCCTTTTGCT GGCCTTTTGC TCACATGTTT TTTCTGCGT TATCCCCTGA TTCTGTGGAT	
2461	AACCGTATTA CCGCTAGCAT GGATCTCGGG GACGTCTAAC TACTAAGCGA GAGTAGGGAA	
2521	CTGCCAGGCA TCAAAATAAA CGAAAGGCTC AGTCGGAAGA CTGGGCCTTT CGTTTTATCT	
2581	GTTGTTTGTC GGTGAACGCT CTCCTGAGTA GGACAAATCC GCCGGGAGCG GATTTGAACG	
2641	TTGTGAAGCA ACGGCCCGGA GGGTGGCGGG CAGGACGCCC GCCATAAACT GCCAGGCATC	
2701	AAACTAAGCA GAAGGCCATC	

FIGURE 13B

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Figure 14A: Cloning sites of the Entry Vector pENTR25



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pENTR5 2720 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
324..629		ccdB
658..757		attL2
880..1689		KmR
1794..2367		ori
1	CTGACGGATG GCCTTTTTGC GTTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC	
61	GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT	
121	AAGCAATGCT TTTTATAAAT GCCAACTTTG TACAAAAAAG CAGGCTTTCA TATGGGAACC	
181	AATTCAGTCG ACTGGATCCG GTACCGAATT CGCTTACTAA AAGCCAGATA ACAGTATGCG	
241	TATTTGCGCG CTGATTTTTG CGGTATAAGA ATATATACTG ATATGTATAC CCGAAGTATG	
301	TCAAAAAGAG GTGTGCTTCT AGAATGCAGT TTAAGGTTTA CACCTATAAA AGAGAGAGCC	
361	GTTATCGTCT GTTTGTGGAT GTACAGAGTG ATATTATTGA CACGCCCGGG CGACGGATGG	
421	TGATCCCCCT GGCCAGTGCA CGTCTGCTGT CAGATAAAGT CTCCCGTGAA CTTTACCCGG	
481	TGGTGCAATAT CGGGGATGAA AGCTGGCGCA TGATGACCAC CGATATGGCC AGTGTGCCGG	
541	TCTCCGTTAT CGGGGAAGAA GTGGCTGATC TCAGCCACCG CGAAAATGAC ATCAAAAACG	
601	CCATTAAACCT GATGTTCTGG GGAATATAGA ATTCGCGGCC GCACTCGAGA TATCTAGACC	
661	CAGCTTTCTT GTACAAAGTT GGCATTATAA GAAAGCATTG CTTATCAATT TGTTCGAACG	
721	AACAGGTCAC TATCAGTCAA AATAAAATCA TTATTTGCCA TCCAGCTGCA GCTCTGGCCC	
781	GTGTCTCAAA ATCTCTGATG TTACATTGCA CAAGATAAAA ATATATCATC ATGAACAATA	
841	AAACTGTCTG CTTACATAAA CAGTAATACA AGGGGTGTTA TGAGCCATAT TCAACGGGAA	
901	ACGTCGAGGC CGCGATTAAA TTCCAACATG GATGCTGATT TATATGGGTA TAAATGGGCT	
961	CGCGATAATG TCGGGCAATC AGGTGCGACA ATCTATCGCT TGTATGGGAA GCCCGATGCG	
1021	CCAGAGTTGT TTCTGAAACA TGGCAAAGGT AGCGTTGCCA ATGATGTTAC AGATGAGATG	
1081	CTCAGACTAA ACTGGCTGAC GGAATTTATG CCTCTTCCGA CCATCAAGCA TTTTATCCGT	
1141	ACTCCTGATG ATGCATGGTT ACTCAACACT GCGATCCCGG GAAAAACAGC ATTCCAGGTA	
1201	TTAGAAGAAT ATCCTGATTC AGGTGAAAAT ATTGTTGATG CGCTGGCAGT GTTCTGCGC	
1261	CGGTTGCATT CGATTCTGTG TTGTAATTGT CCTTTTAACA GCGATCGCGT ATTTCTGCTC	
1321	GCTCAGGCGC AATCACGAAT GAATAACGGT TTGGTTGATG CGAGTGATTT TGATGACGAG	
1381	CGTAATGGCT GGCCTGTTGA ACAAGTCTGG AAAGAAATGC ATAAACTTTT GCCATTCTCA	
1441	CCGATTTCAG TCGTCACTCA TGGTGATTTT TCACTTGATA ACCTTATTTT TGACGAGGGG	
1501	AAATTAATAG GTTGTATTGA TGTGGACGA GTCGGAATCG CAGACCGATA CCAGGATCTT	
1561	GCCATCCTAT GGAACAGCCT CGGTGAGTTT TCTCCTTCAT TACAGAAACG GCTTTTTCAA	
1621	AAATATGGTA TGGATAATCC TGATATGAAT AAATTGCAGT TTCATTGATG GCTCGATGAG	
1681	TTTTTCTAAT CAGAATTGGT TAATTGGTTG TAACATTATT CAGATTGGGC CCCGTTCCAC	
1741	TGAGCGTCAG ACCCCGTAGA AAAGATCAAA GGATCTTCTT GAGATCCTTT TTTTCTGCGC	
1801	GTAATCTGCT GCTTGCAAAC AAAAAAACCA CCGTACCAG CGGTGGTTTG TTTGCCGGAT	
1861	CAAGAGCTAC CAACTCTTTT TCCGAAGGTA ACTGGCTTCA GCAGAGCGCA GATACCAAAT	
1921	ACTGTTCTTC TAGTGTAGCC GTAGTTAGGC CACCACTTCA AGAACTCTGT AGCACCGCCCT	
1981	ACATACCTCG CTCTGCTAAT CCTGTTACCA GTGGCTGCTG CCAGTGGCGA TAAGTCGTGT	
2041	CTTACCGGGT TGGACTCAAG ACGATAGTTA CCGGATAAGG CGCAGCGGTC GGGCTGAACG	
2101	GGGGGTTCTG GCACACAGCC CAGCTTGGAG CGAACGACCT ACACCGAATC GAGATACCTA	
2161	CAGCGTGAGC TATGAGAAAG CGCCACGCTT CCCGAAGGGA GAAAGGCGGA CAGGTATCCG	
2221	GTAAGCGGCA GGGTCGGAAC AGGAGAGCGC ACGAGGGAGC TTCCAGGGGG AAACGCCTGG	
2281	TATCTTTATA GTCCTGTCGG GTTTCGCCAC CTCTGACTTG AGCGTCGATT TTTGTGATGC	
2341	TCGTCAGGGG GCGGAGCCT ATGGA AAAAC GCCAGCAACG CGGCCTTTT ACGGTTCTCTG	
2401	GCCTTTTGCT GGCCTTTTGC TCACATGTTT TTTCTGCGT TATCCCTGA TTCTGTGGAT	
2461	AACCGTATTA CCGCTAGCAT GGATCTCGGG GACGTCTAAC TACTAAGCGA GAGTAGGGAA	
2521	CTGCCAGGCA TCGAATAAAA CGAAAGGCTC AGTCGGAAGA CTGGGCCTTT CGTTTTATCT	
2581	GTTGTTTGTC GGTGAACGCT CTCCTGAGTA GGACAAATCC GCCGGGAGCG GATTTGAACG	
2641	TTGTGAAGCA ACGGCCCGGA GGGTGGCGGG CAGGACGCCC GCCATAAACT GCCAGGCATC	
2701	AAACTAAGCA GAAGGCCATC	

FIGURE 14B

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Figure 15A: Cloning sites of the Entry Vector pENTR6

Int attL1 Sph I Kpn I Xba I Sma I
~~5'~~ ~~3'~~ ~~5'~~ ~~3'~~ ~~5'~~ ~~3'~~ ~~5'~~ ~~3'~~ ~~5'~~ ~~3'~~ ~~5'~~ ~~3'~~ ~~5'~~ ~~3'~~ ~~5'~~ ~~3'~~
 tac aac aac aac gca ggc tgc atg cga acc aat tca gtc
 ttt cgt ccg att tac gct tgg tta agt cag
 Leu Tyr Lys Lys Ala Gly Cys Met Arg Thr Asn Ser Val

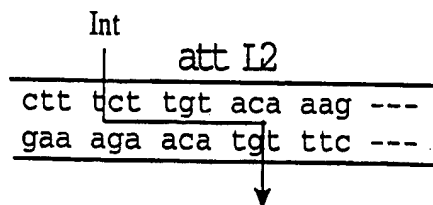
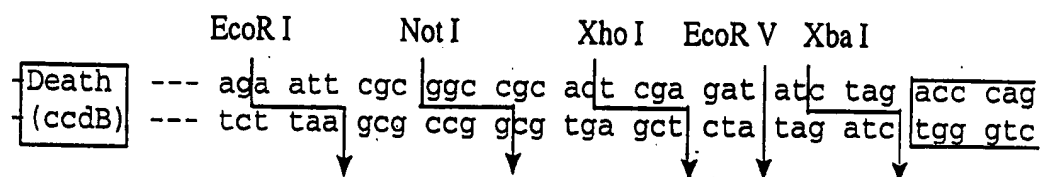
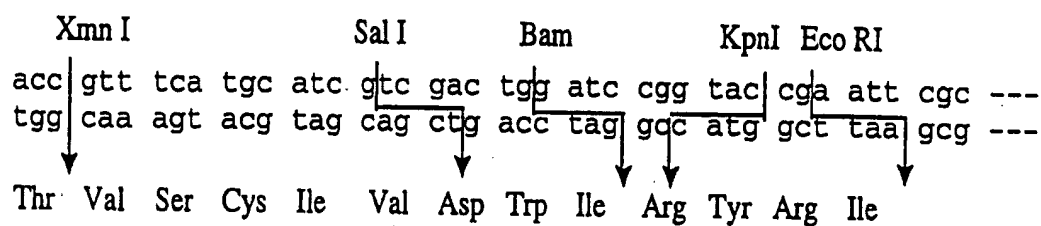
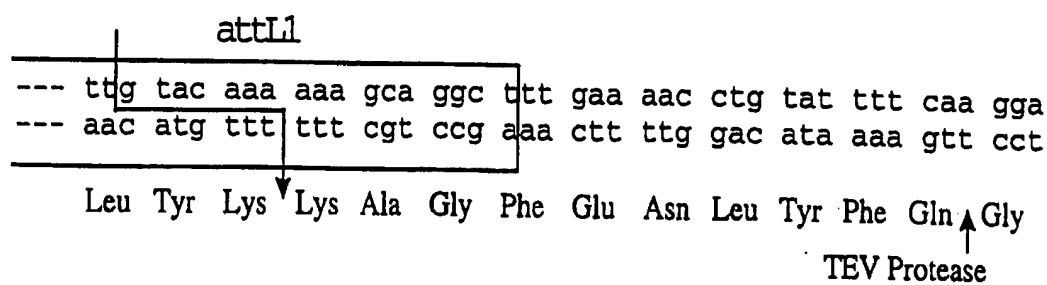
BamH I Kpn I EpeR I EpeR I
 gac tgg atc cgg tac cga att cgc --- Death --- aga att cgc
 cgg acc tag ggc atg gct taa ggc --- (codB) --- tct taa ggc
 Asp Trp Ile Arg Tyr Arg Ile

Not Xho I EpeR I Xba I Int attL2
 ggc cgc act cga gat atc tag acc cag att tgc tgc aca dag ---
 ccg ggc tga gct cta tag atc tgg gtc gaa aga aca tgc ttc ---

pENTR6 2717 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
321..626		ccdB
655..754		attL2
877..1686		KmR
1791..2364		ori
1	CTGACGGATG GCCTTTTTGC GTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC	
61	GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT	
121	AAGCAATGCT TTTTATAAT GCCAACTTTG TACAAAAAAG CAGGCTGCAT GCGAACCAAT	
181	TCAGTCGACT GGATCCGTA CCGAATTCGC TTACTAAAAG CCAGATAACA GTATGCGTAT	
241	TTGCGCGCTG ATTTTTCGG TATAAGAATA TATACTGATA TGTATACCCG AAGTATGTCA	
301	AAAAGAGGTG TGCTTCTAGA ATGCAGTTTA AGGTTTACAC CTATAAAAGA GAGAGCCGTT	
361	ATCGTCTGTT TGTGGATGTA CAGAGTGATA TTATTGACAC GCCCGGGCGA CGGATGGTGA	
421	TCCCCCTGGC CAGTGCACGT CTGCTGTCAG ATAAAGTCTC CCGTGAACCT TACCCGGTGG	
481	TGCATATCGG GGATGAAAGC TGGCGCATGA TGACCACCGA TATGGCCAGT GTGCCGCTCT	
541	CCGTTATCGG GGAAGAAGTG GCTGATCTCA GCCACCGCGA AAATGACATC AAAACGCCA	
601	TTAACCTGAT GTTCTGGGGA ATATAGAATT CGCGGCCGCA CTCGAGATAT CTAGACCCAG	
661	CTTTCTTGTA CAAAGTTGGC ATTATAAGAA AGCATTGCTT ATCAATTGTG TGCAACGAAC	
721	AGGTCACTAT CAGTCAAAAT AAAATCATT TTTGCCATCC AGCTGCAGCT CTGGCCCGTG	
781	TCTCAAAATC TCTGATGTTA CATTGCACAA GATAAAATA TATCATCATG AACAATAAAA	
841	CTGTCTGCTT ACATAAACAG TAATACAAGG GGTGTTATGA GCCATATTCA ACGGGAAACG	
901	TCGAGGCCGC GATTAAATTC CAACATGGAT GCTGATTTAT ATGGGTATAA ATGGGCTCGC	
961	GATAATGTCT GGCAATCAGG TGCGACAATC TATCGCTTGT ATGGGAAGCC CGATGCGCCA	
1021	GAGTTGTTTC TGAAACATGG CAAAGGTAGC GTTGCCAATG ATGTTACAGA TGAGATGGTC	
1081	AGACTAAACT GGCTGACGGA ATTTATGCCT CTTCCGACCA TCAAGCATT TATCCGTACT	
1141	CCTGATGATG CATGGTTACT CACCAGTGGC ATCCCGGAA AACAGCATT CCAGGTATTA	
1201	GAAGAATATC CTGATTCAGG TGAAAATATT GTTGATGCGC TGGCAGTGT TCTGCGCCGG	
1261	TTGCATTCTG TTCTGTTTG TAATTGTCCT TTTAACAGCG ATCGCGTATT TCGTCTCGCT	
1321	CAGGCGCAAT CACGAATGAA TAACGGTTTG GTTGATGCGA GTGATTTTGA TGACGAGCGT	
1381	AATGGCTGGC CTGTTGAACA AGTCTGGAAG GAAATGCATA AACTTTTGCC ATTCTCACCG	
1441	GATTTCAGTC TCACTCATGG TGATTTCTCA CTTGATAACC TTATTTTGA CGAGGGGAAA	
1501	TTAATAGGTT GTATTGATGT TGGACGAGTC GGAATCGCAG ACCGATACCA GGATCTTGCC	
1561	ATCCTATGGA ACTGCCTCGG TGAGTTTCTC CCTTCATTAC AGAAACGGCT TTTTCAAAAA	
1621	TATGGTATTG ATAATCCTGA TATGAATAAA TTGCAGTTTC ATTTGATGCT CGATGAGTTT	
1681	TTCTAATCAG AATTGGTTAA TTGGTTGTAA CATTATTGAG ATTGGGCCCC GTTCCACTGA	
1741	GCGTCAGACC CCGTAGAAAA GATCAAAGGA TCTTCTTGAG ATCCTTTTTT TCTGCGCGTA	
1801	ATCTGCTGCT TGCAAAACAA AAAACCACCG CTACCAGCGG TGGTTTGTTT GCCGGATCAA	
1861	GAGCTACCAA CTCTTTTCC GAAGGTAACCT GGCTTCAGCA GAGCGCAGAT ACCAAATACT	
1921	GTTCTTCTAG TGTAGCCGTA GTTAGGCCAC CACTTCAAGA ACTCTGTAGC ACCGCCTACA	
1981	TACCTCGCTC TGCTAATCCT GTTACCAGTG GCTGCTGCCA GTGGCGATAA GTCGTGTCTT	
2041	ACCGGGTTGG ACTCAAGACG ATAGTTACCG GATAAGGCGC AGCGGTCGGG CTGAACGGGG	
2101	GGTTCGTGCA CACAGCCCAG CTTGGAGCGA ACGACCTACA CCGAACTGAG ATACCTACAG	
2161	CGTGAGCTAT GAGAAAGCGC CACGCTTCCC GAAGGGAGAA AGGCGGACAG GTATCCGGTA	
2221	AGCGGCAGGG TCGGAACAGG AGAGCGCACG AGGGAGCTTC CAGGGGGAAA CGCCTGGTAT	
2281	CTTTATAGTC CTGTCGGGTT TCGCCACCTC TGAATTGAGC GTCGATTTT GTGATGCTCG	
2341	TCAGGGGGGC GGAGCCTATG GAAAAACGCC AGCAACGCGG CCTTTTTACG GTTCTGGGCC	
2401	TTTTGTGGC CTTTGTCTCA CATGTTCTTT CCTGCGTTAT CCCCTGATTC TGTGGATAAC	
2461	CGTATTACCG CTAGCATGGA TCTCGGGGAC GTCTAACTAC TAAGCGAGAG TAGGGAACTG	
2521	CCAGGCATCA AATAAAACGA AAGGCTCAGT CGGAAGACTG GGCCTTTCGT TTTATCTGTT	
2581	GTTTGTGGT GAACGCTCTC CTGAGTAGGA CAAATCCGCC GGGAGCGGAT TTGAACGTTG	
2641	TGAAGCAACG GCCCGGAGGG TGGCGGGCAG GACGCCCCGC ATAACTGCC AGGCATCAAA	
2701	CTAAGCAGAA GGCCATC	

Figure 16A: Cloning sites of the Entry Vector pENTR7



pENTR7 2738 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
342..647		ccdB
676..775		attL2
898..1707		KmR
1812..2385		ori
1	CTGACGGATG GCCTTTTTCG GTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC	
61	GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT	
121	AAGCAATGCT TTTTATAAT GCCAACTTTG TACAAAAAAG CAGGCTTTGA AAACCTGTAT	
181	TTTCAAGGAA CCGTTTCATG CATCGTCGAC TGGATCCGGT ACCGAATTCG CTTACTAAAA	
241	GCCAGATAAC AGTATGCGTA TTTGCGCGCT GATTTTTGCG GTATAAGAAT ATATACTGAT	
301	ATGTATACCC GAAGTATGTC AAAAAGAGGT GTGCTTCTAG AATGCAGTTT AAGGTTTACA	
361	CCTATAAAAG AGAGAGCCGT TATCGTCTGT TTGTGGATGT ACAGAGTGAT ATTATTGACA	
421	CGCCCCGGCG ACGGATAGTG ATCCCCCTGG CCAGTGCACG TCTGCTGTCA GATAAAGTCT	
481	CCCGTGAAC TACCCCGGTG GTGCATATCG GGGATGAAAG CTGGCGCATG ATGACCACCG	
541	ATATGGCCAG TGTGCCGGTC TCCGTTATCG GGGGAAGAAGT GGCTGATCTC AGCCACCGCG	
601	AAAATGACAT CAAAAACGCC ATTAACCTGA TGTCTGGGG AATATAGAAT TCGCGGCCGC	
661	ACTCGAGATA TCTAGACCCA GCTTCTTGTG ACAAAGTTGG CATTATAAGA AAGCATTGCT	
721	TATCAATTG TTGCAACGAA CAGGTCACTA TCAGTCAAAA TAAAATCATT ATTTGCCATC	
781	CAGTCGCAGC TCTGGCCCGT GTCTCAAAAT CTCTGATGTT ACATTGCACA AGATAAAAAT	
841	ATATCATCAT GAACAATAAA ACTGTCTGCT TACATAACA GTAATACAAG GGGTGTATG	
901	AGCCATATTC AACGGGAAAC GTCGAGGCCG CGATTAAATT CCAACATGGA TGCTGATTTA	
961	TATGGGTATA AATGGGCTCG CGATAATGTC GGGCAATCAG GTGCGACAAT CTATCGCTTG	
1021	TATGGGAAGC CCGATGCGCC AGAGTTGTTT CTGAAACATG GCAAAGGTAG CGTTGCCAAT	
1081	GATGTTACAG ATGAGATGGT CAGACTAAAC TGGCTGACGG AATTTATGCC TCTTCCGACC	
1141	ATCAAGCATT TTATCCGTAC TCCTGATGAT GCATGGTTAC TCACCACTGC GATCCCCGGA	
1201	AAACAGCAT TCCAGGTATT AGAAGAATAT CCTGATTAG GTGAAAATAT TGTGTATGCG	
1261	CTGGCAGTGT TCCTGCGCCG GTTGCAATCG ATTCCTGTTT GTAATTGTCC TTTTAACAGC	
1321	GATCGCGTAT TTCGTCTCGC TCAGGCGCAA TCACGAATGA ATAACGGTTT GGTGTATGCG	
1381	AGTGATTTTG ATGACGAGCG TAATGGCTGG CCTGTTGAAC AAGTCTGGAA AGAAATGCAT	
1441	AACTTTTTCG CATTCTCACC GGATTCAGTC GTCACTCATG GTGATTTCTC ACTTGATAAC	
1501	CTTATTTTTC ACGAGGGGAA ATTAATAGGT TGTATTGATG TTGGACGAGT CGGAATCGCA	
1561	GACCGATACC AGGATCTTGC CATCCTATGG AACTGCCTCG GTGAGTTTTT TCCTTCATTA	
1621	CAGAAACGGC TTTTCAAAA ATATGGTATT GATAATCCTG ATATGAATAA ATTGCAGTTT	
1681	CATTTGATGC TCGATGAGTT TTTCTAATCA GAATTGGTTA ATTGGTTGTA ACATTATTCA	
1741	GATTGGGCCC CGTTCCACTG AGCGTCAGAC CCCGTAGAAA AGATCAAAGG ATCTTCTTGA	
1801	GATCCTTTTT TTCTGCGCGT AATCTGCTGC TTGCAAAACAA AAAAACCACC GCTACCAGCG	
1861	GTGGTTTGTT TGCCGGATCA AGAGCTACCA ACTCTTTTTT CGAAGGTAAC TGGCTTCAGC	
1921	AGAGCGCAGA TACCAAATAC TGTCTTCTA GTGTAGCCGT AGTTAGGCCA CCACTTCAAG	
1981	AACTCTGTAG CACCGCCTAC ATACCTCGCT CTGCTAATCC TGTACCAGT GGCTGCTGCC	
2041	AGTGGCGATA AGTCGTGTCT TACCGGGTTG GACTCAAGAC GATAGTTACC GGATAAGGCG	
2101	CAGCGGTCGG GCTGAACGGG GGGTTCGTGC ACACAGCCCA GCTTGGAGCG AACGACCTAC	
2161	ACCGAACTGA GATACCTACA GCGTGAGCTA TGAGAAAGCG CCACGCTTCC CGAAGGGAGA	
2221	AAGGCGGACA GGTATCCGGT AAGCGGCAGG GTCGGAACAG GAGAGCGCAC GAGGGAGCTT	
2281	CCAGGGGGAA ACGCCTGGTA TCTTTATAGT CCTGTGGGGT TTCGCCACCT CTGACTTGAG	
2341	CGTCGATTTT TGTGATGCTC GTCAGGGGGG CGGAGCCTAT GGAAAAACGC CAGCAACGCG	
2401	GCCTTTTAC GGTTCCTGGC CTTTGTCTGG CCTTTTGCTC ACATGTTCTT TCCTGCGTTA	
2461	TCCCCTGATT CTGTGGATAA CCGTATTACC GCTAGCATGG ATCTCGGGGA CGTCTAACTA	
2521	CTAAGCGAGA GTAGGGAAC GCCAGGCATC AAATAAAACG AAAGGCTCAG TCGGAAGACT	
2581	GGGCCTTTTC TTTTATCTGT TGTGTGTCGG TGAACGCTCT CCTGAGTAGG ACAAATCCGC	
2641	CGGGAGCGGA TTTGAACGTT GTGAAGCAAC GGCCCGGAGG GTGGCGGGCA GGACGCCCGC	
2701	CATAAACTGC CAGGCATCAA ACTAAGCAGA AGGCCATC	

FIGURE 16B

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Figure 17A: Cloning Sites of the *ENTY* Vector: pENTR8

Int attL1

ctt tac aaa aaa gca ggc ttt	gaa aac ctg tat ttt caa gga
gag atg gtc ttt cgt ccg aaa	ctt ttg gac ata aaa gtt cct
Leu Tyr Lys Lys Ala Gly Phe	Glu Asn Leu Tyr Phe Gln Gly

TEV Protease

NotI HaeII SalI BamHI KpnI EcoRI

act atg gac	cta gtc gac tgg atc cgg tac	cga att cgc ---
tgg tac ctg	gat cag cgg acc tag gca atg gct taa	gcg ---
Thr Met Asp	Leu Val Asp Trp Ile Arg Tyr Arg Ile	

EcoRI NotI XhoI EcoRI XbaI attL

Death ---	aga att cgc ggc cgc act cga gat atc tag	acc cag
---	tct taa gcg ccg ggg tga gct cta tag atc	tgg gtc

Int

ctt tct ggt aca aac ---
gaa aga aca tgt ttc ---

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pENTR8 2735 bp

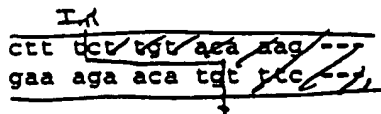
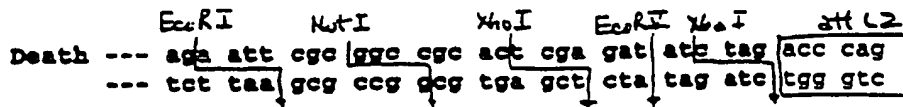
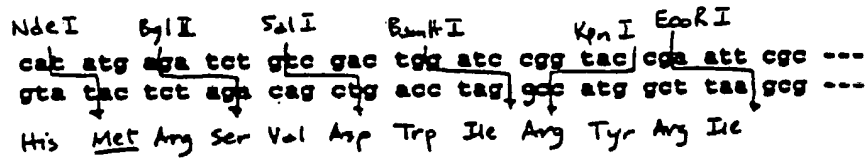
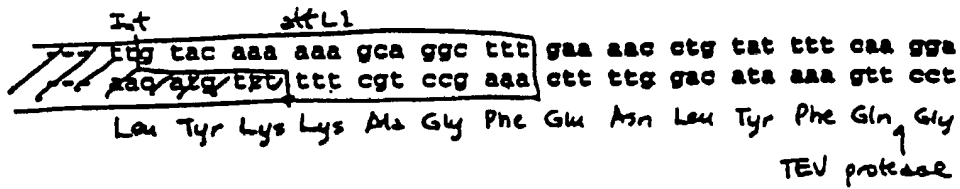
<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
339..644		ccdB
673..772		attL2
895..1704		KmR
1809..2382		ori

1	CTGACGGATG	GCCTTTTTGC	GTTTCTACAA	ACTCTTCCTG	TTAGTTAGTT	ACTTAAGCTC
61	GGGCCCCAAA	TAATGATTTT	ATTTTGACTG	ATAGTGACCT	GTTTCGTTGCA	ACAAATTGAT
121	AAGCAATGCT	TTTTTATAAT	GCCAACTTTG	TACAAAAAAG	CAGGCTTTGA	AAACCTGTAT
181	TTTCAAGGAA	CCATGGACCT	AGTCGACTGG	ATCCGGTACC	GAATTCGCTT	ACTAAAAGCC
241	AGATAACAGT	ATGCGTATTT	GCGCGCTGAT	TTTTGCGGTA	TAAGAATATA	TACTGATATG
301	TATACCCGAA	GTATGTCAAA	AAGAGGTGTG	CTTCTAGAAT	GCAGTTTAAG	GTTTACACCT
361	ATAAAAGAGA	GAGCCGTTAT	CGTCTGTTTG	TGGATGTACA	GAGTGATATT	ATTGACACGC
421	CCGGGCGACG	GATAGTGATC	CCCCTGGCCA	GTGCACGTCT	GCTGTCAGAT	AAAGTCTCCC
481	GTGAACTTTA	CCCGGTGGTG	CATATCGGGG	ATGAAAGCTG	GCGCATGATG	ACCACCGATA
541	TGGCCAGTGT	GCCGGTCTCC	GTTATCGGGG	AAGAAGTGGC	TGATCTCAGC	CACCGCGAAA
601	ATGACATCAA	AAACGCCATT	AACCTGATGT	TCTGGGGAAT	ATAGAATTCC	CGGCCGCACT
661	CGAGATATCT	AGACCCAGCT	TTCTTGATCA	AAGTTGGCAT	TATAAGAAAG	CATTGCTTAT
721	CAATTTGTTG	CAACGAACAG	GTCACTATCA	GTCAAATAAA	AATCATTATT	TGCCATCCAG
781	CTGCAGCTCT	GGCCCGTGTC	TCAAAATCTC	TGATGTTACA	TTGCACAAGA	TAAAAATATA
841	TCATCATGAA	CAATAAACT	GTCTGCTTAC	ATAAACAGTA	ATACAAGGGG	TGTTATGAGC
901	CATATTC AAC	GGGAAACGTC	GAGGCCGCGA	TTAAATTCCA	ACATGGATGC	TGATTTATAT
961	GGGTATAAAT	GGGCTCGCGA	TAATGTCGGG	CAATCAGGTG	CGACAATCTA	TCGCTTGTAT
1021	GGGAAGCCCG	ATGCGCCAGA	GTTGTTTCTG	AAACATGGCA	AAGGTAGCGT	TGCCAATGAT
1081	GTTACAGATG	AGATGGTCAG	ACTAACTGGA	CTGACGGAAT	TTATGCCTCT	CCCCACCATC
1141	AAGCATTTTA	TCCGTACTCC	TGATGATGCA	TGGTTACTCA	CCACTGCGAT	CCCCGGAAAA
1201	ACAGCATTCC	AGGTATTAGA	AGAATATCCT	GATTCAGGTG	AAAATATTGT	TGATGCGCTG
1261	GCAGTGTCCT	TGCGCCGGTT	GCATTGATTT	CCTGTTTGTA	ATTGTCCTTT	TAACAGCGAT
1321	CGCGTATTTT	GTCTCGCTCA	GGCGCAATCA	CGAATGAATA	ACGGTTTGGT	TGATGCGAGT
1381	GATTTTGTATG	ACGAGCGTAA	TGGCTGGCCT	GTTGAACAAG	TCTGGAAAGA	AATGCATAAA
1441	CTTTTGCCAT	TCTCACC GGA	TTCAGTCGTC	ACTCATGGTG	ATTTCTCACT	TGATAACCTT
1501	ATTTTGTGACG	AGGGGAAATT	AATAGGTTGT	ATTGATGTTG	GACGAGTCGG	AATCGCAGAC
1561	CGATACCAGG	ATCTTGCCAT	CCTATGGAAC	TGCCTCGGTG	AGTTTCTCTC	TTCATTACAG
1621	AAACGGCTTT	TTCAAAAATA	TGGTATTGAT	AATCCTGATA	TGAATAAATT	GCAGTTTCAT
1681	TTGATGCTCG	ATGAGTTTTT	CTAATCAGAA	TTGGTTAATT	GGTTGTAAAC	TTATTTCAGAT
1741	TGGGCCCCGT	TCCACTGAGC	GTGAGACCCC	GTAAGAAAAG	TCAAAGGATC	TTCTTGAGAT
1801	CCTTTTTTTC	TGCGCGTAAT	CTGCTGCTTG	CAAACAAAAA	AACCACCGCT	ACCAGCGGTG
1861	GTTTGTGTTG	CGGATCAAGA	GCTACCAACT	CTTTTCCGA	AGGTAAGTGG	CTTCAGCAGA
1921	GCGCAGATAC	CAAATACTGT	TCTTCTAGTG	TAGCCGTAGT	TAGGCCACCA	CTTCAAGAAC
1981	TCTGTAGCAC	CGCCTACATA	CCTCGCTCTG	CTAATCCTGT	TACCAGTGGC	TGCTGCCAGT
2041	GGCGATAAGT	CGTGCTTAC	CGGGTTGGAC	TCAAGACGAT	AGTTACCGGA	TAAGGCGCAG
2101	CGGTCGGGCT	GAACGGGGGG	TTCGTGCACA	CAGCCCAGCT	TGGAGCGAAC	GACCTACACC
2161	GAACGTAGAT	ACCTACAGCG	TGAGCTATGA	GAAAGCGCCA	CGCTTCCCGA	AGGGAGAAAG
2221	CGGGACAGGT	ATCCGTAAG	CGGCAGGGTC	GGAACAGGAG	AGCGCACGAG	GGAGCTTCCA
2281	GGGGGAAACG	CCTGGTATCT	TTATAGTCCT	GTCGGGTTTC	GCCACCTCTG	ACTTGAGCGT
2341	CGATTTTTGT	GATGCTCGTC	AGGGGGGCGG	AGCCTATGGA	AAAACGCCAG	CAACGCGGCC
2401	TTTTTACGGT	TCCTGGCCTT	TTGCTGGCCT	TTTGCTCACA	TGTTCTTTCC	TGCGTTATCC
2461	CCTGATTCTG	TGGATAACCG	TATTACCGCT	AGCATGGATC	TCGGGGACGT	CTAACTACTA
2521	AGCGAGAGTA	GGGAACTGCC	AGGCATCAAA	TAAAACGAAA	GGCTCAGTCG	GAAGACTGGG
2581	CCTTTCGTTT	TATCTGTTGT	TTGTCGGTGA	ACGCTCTCCT	GAGTAGGACA	AATCCGCGCG
2641	GAGCGGATTT	GAACGTTGTG	AAGCAACGGC	CCGGAGGGTG	GCGGGCAGGA	CGCCCGCCAT
2701	AAACTGCCAG	GCATCAAAC	AAGCAGAAGG	CCATC		

Figure 17B

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Figure 18A: Cloning sites of the ENTRY Vector pENTRY



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pENTR9 2735 bp

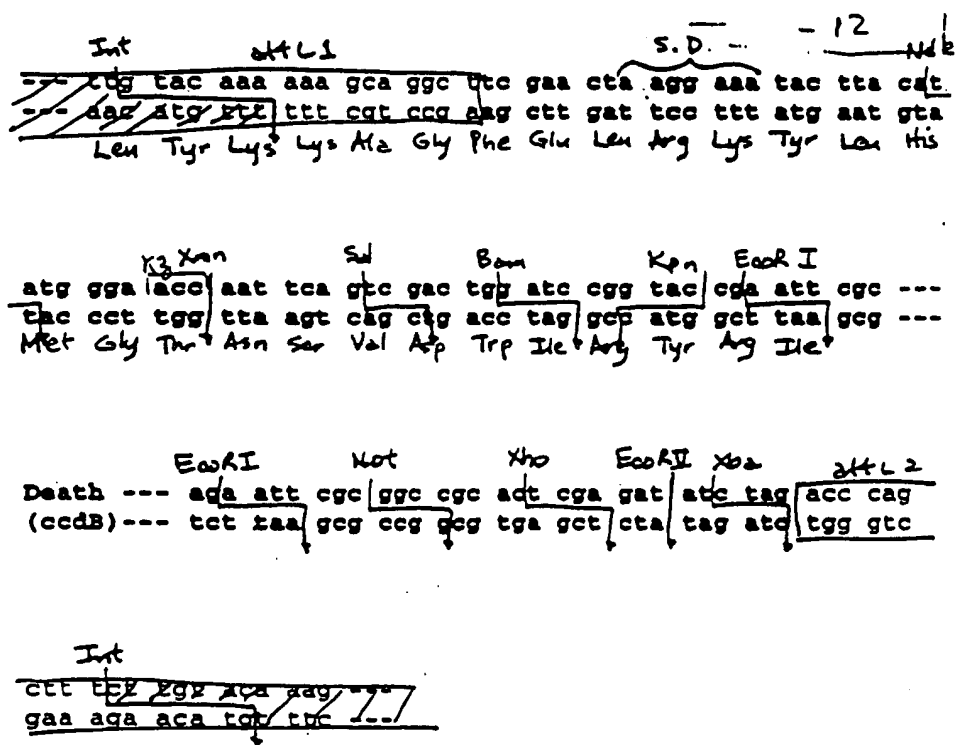
<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
339..644		ccdB
673..772		attL2
895..1704		KmR
1809..2382		ori

1	CTGACGGATG	GCCTTTTTGC	GTTTCTACAA	ACTCTTCCTG	TTAGTTAGTT	ACTTAAGCTC
61	GGGCCCCAAA	TAATGATTTT	ATTTTGACTG	ATAGTGACCT	GTTTCGTTGCA	ACAAATTGAT
121	AAGCAATGCT	TTTTTATAAT	GCCAACTTTG	TACAAAAAAG	CAGGCTTTGA	AAACCTGTAT
181	TTTCAAGGAC	ATATGAGATC	TGTCGACTGG	ATCCGGTACC	GAATTGCTT	ACTAAAAGCC
241	AGATAACAGT	ATGCGTATTT	GCGCGCTGAT	TTTTGCGGTA	TAAGAATATA	TACTGATATG
301	TATACCCGAA	GTATGTCAAA	AAGAGGTGTG	CTTCTAGAAT	GCAGTTTAAG	GTTTACACCT
361	ATAAAAGAGA	GAGCCGTTAT	CGTCTGTTTG	TGGATGTACA	GAGTGATATT	ATTGACACGC
421	CCGGGCGACG	GATAGTGATC	CCCCTGGCCA	GTGCACGTCT	GCTGTCAGAT	AAAGTCTCCC
481	GTGAACTTTA	CCCGGTGGTG	CATATCGGGG	ATGAAAGCTG	GCGCATGATG	ACCACCGATA
541	TGGCCAGTGT	GCCGGTCTCC	GTTATCGGGG	AAGAAGTGGC	TGATCTCAGC	CACCGCGAAA
601	ATGACATCAA	AAACGCCATT	AACCTGATGT	TCTGGGGAAT	ATAGAATTCT	CGGCCGCACT
661	CGAGATATCT	AGACCCAGCT	TTCTTGATCA	AAGTTGGCAT	TATAAGAAAG	CATTGCTTAT
721	CAATTTGTTG	CAACGAACAG	GTCACATCA	GTCAAATAA	AATCATTATT	TGCCATCCAG
781	CTGCAGCTCT	GGCCCGTGTC	TCAAAATCTC	TGATGTTACA	TTGCACAAGA	TAAAAATATA
841	TCATCATGAA	CAATAAACT	GTCTGCTTAC	ATAAACAGTA	ATACAAGGGG	TGTTATGAGC
901	CATATTCAAC	GGGAAACGTC	GAGGCCGCGA	TTAAATTCCA	ACATGGATGC	TGATTTATAT
961	GGGTATAAAT	GGGCTCGCGA	TAATGTCGGG	CAATCAGGTG	CGACAATCTA	TCGCTTGAT
1021	GGGAAGCCCG	ATGCGCCAGA	GTTGTTTCTG	AAACATGGCA	AAGGTAGCGT	TGCCAATGAT
1081	GTTACAGATG	AGATGGTCAG	ACTAACTGG	CTGACGGAAT	TTATGCCTCT	TCCGACCATC
1141	AAGCATTTTA	TCCGTACTCC	TGATGTGCA	TGGTTACTCA	CCACTGCGAT	CCCCGGAAAA
1201	ACAGCATTCC	AGGTATTAGA	AGAATATCCT	GATTTCAGGTG	AAAATATTGT	TGATGCGCTG
1261	GCAGTGTC	TGCGCCGGTT	GCATTCGATT	CCTGTTTGTA	ATTGTCCTTT	TAACAGCGAT
1321	CGCGTATTTT	GTCTCGCTCA	GGCGCAATCA	CGAATGAATA	ACGGTTTGGT	TGATGCGAGT
1381	GATTTTGATG	ACGAGCGTAA	TGGCTGGCCT	GTTGAACAAG	TCTGGAAAGA	AATGCATAAA
1441	CTTTTGCCAT	TCTCACCCTG	TTTCTGCTG	ACTCATGGTG	ATTTCTCACT	TGATAACCTT
1501	ATTTTGTACG	AGGGGAAATT	AATAGGTTGT	ATTGATGTTG	GACGAGTCGG	AATCGCAGAC
1561	CGATACCAGG	ATCTTGCCAT	CCTATGGAAC	TGCCTCGGTG	AGTTTTCTCC	TTCAATTACAG
1621	AAACGGCTTT	TTCAAAAAATA	TGGTATTGAT	AATCCTGATA	TGAATAAATT	GCAGTTTCAT
1681	TTGATGCTCG	ATGAGTTTTT	CTAATCAGAA	TTGGTTAATT	GGTTGTAACA	TTATTTCAGAT
1741	TGGGCCCCGT	TCCACTGAGC	GTCAGACCCC	GTAGAAAAAGA	TCAAAGGATC	TTCTTGAGAT
1801	CCTTTTTTTC	TGCGCGTAAT	CTGCTGCTTG	CAAACAAAAA	AACCACCGCT	ACCAGCGGTG
1861	GTTTGTTTGC	CGGATCAAGA	GCTACCAACT	CTTTTTCCGA	AGGTAAGTGG	CTTCAGCAGA
1921	GCGCAGATAC	CAAATACTGT	TCTTCTAGTG	TAGCCGTAGT	TAGGCCACCA	CTTCAAGAAC
1981	TCTGTAGCAC	CGCCTACATA	CCTCGCTCTG	CTAATCCTGT	TACCAGTGGC	TGCTGCCAGT
2041	GGCGATAAGT	CGTGTCTTAC	CGGGTTGGAC	TCAAGACGAT	AGTTACCGGA	TAAGGCGCAG
2101	CGGTGCGGCT	GAACGGGGGG	TTCTGTCACA	CAGCCCAGCT	TGGAGCGAAC	GACCTACACC
2161	GAACTGAGAT	ACCTACAGCG	TGAGCTATGA	GAAAGCGCCA	CGCTTCCCGA	AGGGAGAAAG
2221	GCGCAGAGGT	ATCCGGTAAG	CGGCAGGGTC	GGAACAGGAG	AGCGCAGCAG	GGAGCTTCCA
2281	GGGGGAAACG	CCTGGTATCT	TTATAGTCCT	GTCGGGTTTC	GCCACCTCTG	ACTTGAGCGT
2341	CGATTTTGTG	GATGCTCGTC	AGGGGGGCGG	AGCCTATGGA	AAAACGCCAG	CAACGCGGCC
2401	TTTTTACGGT	TCCTGGCCTT	TTGCTGGCCT	TTTGCTCACA	TGTTCTTTCC	TGCGTTATCC
2461	CCTGATTCTG	TGGATAACCG	TATTACCGCT	AGCATGGATC	TCGGGGACGT	CTAACTACTA
2521	AGCGAGAGTA	GGGAAGTGGC	AGGCATCAAA	TAAAACGAAA	GGCTCAGTCG	GAAGACTGGG
2581	CCTTTCGTTT	TATCTGTTGT	TTGTCGGTGA	ACGCTCTCCT	GAGTAGGACA	AATCCGCCCG
2641	GAGCGGATTT	GAACGTTGTG	AAGCAACGGC	CCGGAGGGTG	GCGGGCAGGA	CGCCCGCCAT
2701	AAACTGCCAG	GCATCAAAC	AAGCAGAGG	CCATC		

FIGURE 18B

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Figure 19A: Cloning sites of the ENTRY Vector pENTRY10



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pENTR10 2738 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
342..647		ccdB
676..775		attL2
898..1707		KmR
1812..2385		ori
1	CTGACGGATG GCCTTTTTCG GTTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC	
61	GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT	
121	AAGCAATGCT TTTTATAAT GCCAACTTTG TACAAAAAAG CAGGCTTCGA ACTAAGGAAA	
181	TACTTACATA TGGGAACCAA TTCAGTCGAC TGGATCCGGT ACCGAATTCG CTTACTAAAA	
241	GCCAGATAAC AGTATGCGTA TTTGCGCGCT GATTTTTCG GTATAAGAAT ATATACTGAT	
301	ATGTATACCC GAAGTATGTC AAAAAGAGGT GTGCTTCTAG AATGCAGTTT AAGGTTTACA	
361	CCTATAAAAG AGAGAGCCGT TATCGTCTGT TTGTGGATGT ACAGAGTGAT ATTATTGACA	
421	CGCCCGGGCG ACGGATGGTG ATCCCCCTGG CCAGTGACAG TCTGCTGTCA GATAAAGTCT	
481	CCCGTGAAC TTTACCCGGTG GTGCATATCG GGGATGAAAG CTGGCGCATG ATGACCACCG	
541	ATATGGCCAG TGTGCCGGTC TCCGTTATCG GGAAGAAGT GGCTGATCTC AGCCACCGCG	
601	AAAATGACAT CAAAAACGCC ATTAACCTGA TGTTCCTGGG AATATAGAAT TCGCGGCCCG	
661	ACTCGAGATA TCTAGACCCA GCTTCTTGT ACAAAGTTGG CATTATAAGA AAGCATGTCT	
721	TATCAATTTG TTGCAACGAA CAGGTCAC TAAGTCAAAA TAAATCATT ATTTGCCATC	
781	CAGCTGCAGC TCTGGCCCGT GTCTCAAAAT CTCTGATGTT ACATTGCACA AGATAAAAAAT	
841	ATATCATCAT GAACAATAAA ACTGTCTGCT TACATAAACA GTAATACAAG GGGTGTATATG	
901	AGCCATATTC AACGGGAAAC GTCGAGGCCG CGATTAAAT CCAACATGGA TGCTGATTTA	
961	TATGGGTATA AATGGGCTCG CGATAATGTC GGGCAATCAG GTGCGACAAT CTATCGCTTG	
1021	TATGGGAAGC CCGATGCGCC AGAGTTGTTT CTGAAACATG GCAAAGGTAG CGTTGCCAAT	
1081	GATGTTACAG ATGAGATGGT CAGACTAAAC TGGCTGACGG AATTTATGCC TCTCCGACC	
1141	ATCAAGCAT TTATCCGTAC TCCTGATGAT GCATGGTTAC TCACCACTGC GATCCCCGGA	
1201	AAAACAGCAT TCCAGGTATT AGAAGAATAT CCTGATTCAG GTGAAAAAT TGTGTAGTCG	
1261	CTGGCAGTGT TCCTGCGCCG GTTGCAATCG ATTCCTGTTT GTAATTGTCC TTTTAACAGC	
1321	GATCGCGTAT TTCGTCTCGC TCAGGCGCAA TCACGAATGA ATAACGGTTT GGTGTATGCG	
1381	AGTGATTTTG ATGACGAGCG TAATGGCTGG CCTGTTGAAC AAGTCTGGAA AGAAATGCAT	
1441	AACTTTTTCG CATTCTCACC GGATTCAATG GTCACATCAT GTGATTTCTC ACTTGATAAC	
1501	CTTATTTTTG ACGAGGGGAA ATTAATAGGT TGTATTGATG TTGGACGAGT CGGAATCGCA	
1561	GACCGATACC AGGATCTTGC CATCCTATGG AACTGCCTCG GTGAGTTTTC TCCTTCATTA	
1621	CAGAAACGGC TTTTCAAAA ATATGGTATT GATAATCCTG ATATGAATAA ATTGCAGTTT	
1681	CATTTGATGC TCGATGAGTT TTTCTAATCA GAATTGGTTA ATTGGTTGTA ACATTATTCA	
1741	GATTGGGCCG CGTTCCACTG AGCGTCAGAC CCCGTAGAAA AGATCAAAGG ATCTTCTTGA	
1801	GATCCTTTTT TTCTGCGCGT AATCTGCTGC TTGCAAACAA AAAAACCACC GCTACCAGCG	
1861	GTGGTTTGTT TGCCGGATCA AGAGCTACCA ACTCTTTTTC CGAAGGTAAC TGGCTTCAGC	
1921	AGAGCGCAGA TACCAAATAC TGTTCTTCTA GTGTAGCCGT AGTTAGGCCA CCACTTCAAG	
1981	AACTCTGTAG CACCGCCTAC ATACCTCGCT CTGCTAATCC TGTTACCACT GGCTGCTGCC	
2041	AGTGGCGATA AGTCGTGTCT TACCGGGTTG GACTCAAGAC GATAGTTACC GGATAAGGCG	
2101	CAGCGGTCGG GCTGAACGGG GGGTTCGTGC ACACAGCCCA GCTTGGAGCG AACGACCTAC	
2161	ACCGAAGTGA GATACCTACA GCGTGAGCTA TGAGAAAGCG CCACGCTTCC CGAAGGGAGA	
2221	AAGCGGACGA GGTATCCGGT AAGCGGCAGG GTCGGAACAG GAGAGCGCAC GAGGAGCTT	
2281	CCAGGGGGAA ACGCCTGGTA TCTTTATAGT CCTGTCGGGT TTCGCCACCT CTGACTTGAG	
2341	CGTCGATTTT TGTGATGCTC GTCAGGGGGG CGGAGCCTAT GGAAAAACGC CAGCAACGCG	
2401	GCCTTTTTAC GGTTCCTGGC CTTTGTCTGG CTTTGTCTC ACATGTTCTT TCCTGCGTTA	
2461	TCCCTTGATT CTGTGGATAA CCGTATTACC GCTAGCATGG ATCTCGGGGA CGTCTAACTA	
2521	CTAAGCGAGA GTAGGGAAC GCCAGGCATC GAATAAAACG AAAGGCTCAG TCGGAAGACT	
2581	GGGCCTTTTC TTTTATCTGT TGTTTGTCTG TGAACGCTCT CCTGAGTAGG ACAAATCCGC	
2641	CGGAGCGGA TTTGAACGTT GTGAAGCAAC GGCCCGGAGG GTGGCGGGCA GGACGCCCGC	
2701	CATAAACTGC CAGGCATCAA ACTAAGCAGA AGGCCATC	

FIGURE 19B

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Figure 20A: Cloning Sites of the Entry Vector pENTR11

Int attL1 S.D. Kozak XmnI S.D.

TTG TAC AAA AAA GCA GGC TTC GAA GGA GAT AGA ACC AAT TCT CTA AGG AAA TAC
 AAC ATG TTT TTT CGT CCG AAG CTT CCT CTA TCT TGG TTA AGA GAT TCC TTT ATG

Leu Tyr Lys Lys Ala Gly Phe Glu Gly Asp Arg Thr Asn Ser Leu Arg Lys Tyr

Kozak NcoI SalI BamHI KpnI EcoRI EcoRI NotI

TTA ACC ATG GTC GAC TGG ATC CGG TAC CGA ATT C-- ccdB --G AAT TCG GGG CCG
 AAT TGG TAC CAG CTG ACC TAG GGC ATG GCT TAA G C TTA AGC GCC GGC

Leu Thr Met Val Asp Trp Ile Arg Tyr Arg Ile Asn Ser Arg Pro

XhoI EcoRV XbaI Int attL2

CAC TCG AGA TAT CTA GAC CCA GCT TTC TTG TAC AAA G
 GTG AGC TCT ATA GAT CTG GGT CGA AAG AAC ATG TTT C

His Ser Arg Tyr Leu Asp Pro Ala Phe Leu Tyr Lys

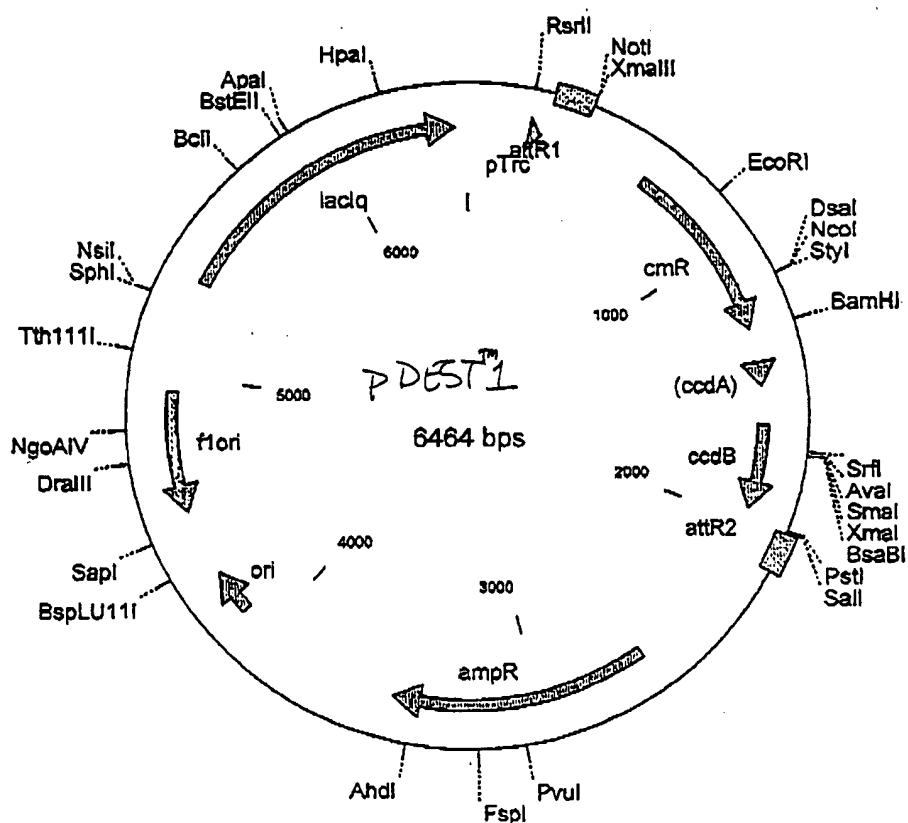
pENTR11 2744 bp (rotated to position 2578)

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
67..166		attL1
348..653		ccdB
683..781		attL2
904..1713		KmR
1818..2391		ori
1	CTGACGGATG GCCTTTTTCG GTTCTACAA ACTCTTCCTG TTAGTTAGTT ACTTAAGCTC	
61	GGGCCCCAAA TAATGATTTT ATTTTGACTG ATAGTGACCT GTTCGTTGCA ACAAATTGAT	
121	AAGCAATGCT TTTTATAAT GCCAACTTTG TACAAAAAAG CAGGCTTCGA AGGAGATAGA	
181	ACCAATTCTC TAAGGAAATA CTTAACCATG GTCGACTGGA TCCGGTACCG AATTCGCTTA	
241	CTAAAAGCCA GATAACAGTA TCGGTATTTG CCGCTGATT TTTGCGGTAT AAGAATATAT	
301	ACTGATATGT ATACCCGAAG TATGTCAAAA AGAGGTGTGC TTCTAGAATG CAGTTTAAGG	
361	TTTACACCTA TAAAAGAGAG AGCCGTTATC GTCTGTTTGT GGATGTACAG AGTGATATTA	
421	TTGACACGCC CGGGCGACGG ATAGTGATCC CCCTGGCCAG TGCACGTCTG CTGTACAGATA	
481	AAGTCTCCCG TGAACTTTAC CCGGTGGTGC ATATCGGGGA TGAAGCTGG CGCATGATGA	
541	CCACCGATAT GGCCAGTGTG CCGTCTCCG TTATCGGGGA AGAAGTGGCT GATCTCAGCC	
601	ACCGCGAAAA TGACATCAAA AACGCCATTA ACCTGATGTT CTGGGGAATA TAGAATTCGC	
661	GGCCGCACTC GAGATATCTA GACCCAGCTT TCTGTACAA AGTTGGCATT ATAAGAAAGC	
721	ATTGCTTATC AATTGTGTG AACGAACAGG TCACTATCAG TCAAAATAAA ATCATTATTT	
781	GCCATCCAGC TGCAGCTCTG GCCCGTGTCT CAAAATCTCT GATGTTACAT TGCACAAGAT	
841	AAAAATATAT CATCATGAAC AATAAACTG TCTGCTTACA TAAACAGTAA TACAAGGGGT	
901	GTTATGAGCC ATATTCAACG GGAACGTCG AGGCCGCGAT TAAATCCAA CATGGATGCT	
961	GATTTATATG GGTATAAATG GGCTCGCGAT AATGTCGGGC AATCAGGTGC GACAATCTAT	
1021	CGCTTGTATG GGAAGCCCGA TGCGCCAGAG TTGTTTCTGA AACATGGCAA AGGTAGCGTT	
1081	GCCAATGATG TTACAGATGA GATGTCAGA CTAACTGGC TGACGGAATT TATGCCTCTT	
1141	CCGACCATCA AGCATTTTAT CCGTACTCCT GATGATGCAT GGTACTCAC CACTGCGATC	
1201	CCCGGAAAAA CAGCATTCCA GGTATTAGAA GAATATCCTG ATTCAGGTGA AAATATTGTT	
1261	GATGCGCTGG CAGTGTTCCT GCGCCGGTTC CATTCGATT C TGTTTGTA TTTGCTCTTT	
1321	AACAGCGATC GCGTATTTCC TCTCGCTCAG GCGCAATCAC GAATGAATA CGGTTTGTT	
1381	GATGCGAGTG ATTTTGATGA CGAGCGTAAT GGCTGGCCTG TTGAACAAGT CTGGAAAGAA	
1441	ATGCATAAAC TTTTGCCATT CTCACCGGAT TCAGTCGTCA CTCATGGTGA TTTCTCACTT	
1501	GATAACCTTA TTTTGACGA GGGGAAATTA ATAGGTTGTA TTGATGTTGG ACGAGTCGGA	
1561	ATCGCAGACC GATACCAGGA TCTTGCCATC CTATGGAAC GCCTCGGTGA GTTTTCTCCT	
1621	TCATTACAGA AACGGCTTTT TCAAAAATAT GGTATTGATA ATCCTGATAT GAATAAATTG	
1681	CAGTTTCATT TGATGCTCGA TGAGTTTTTC TAATCAGAAT TGGTTAATTG GTTGTAACAT	
1741	TATTCAGATT GGGCCCCGTT CCACTGAGCG TCAGACCCCG TAGAAAAGAT CAAAGGATCT	
1801	TCTTGAGATC CTTTTTTTCT GCGCGTAATC TGCTGCTTGC AAACAAAAA ACCACCGCTA	
1861	CCAGCGGTGG TTTGTTTGCC GGATCAAGAG CTACCAACTC TTTTCCGAA GGTAACTGGC	
1921	TTCAGCAGAG CGCAGATACC AAATACTGTT CTTCTAGTGT AGCCGTAGTT AGGCCACCAC	
1981	TTCAAGAACT CTGTAGCACC GCCTACATAC CTCGCTCTGC TAATCCTGTT ACCAGTGGCT	
2041	GCTGCCAGTG GCGATAAGTC GTGTCTTACC GGGTTGGACT CAAGACGATA GTTACCGGAT	
2101	AAGGCGCAGC GGTCCGGCTG AACGGGGGGT TCGTGACAC AGCCAGCTT GGAGCGAACG	
2161	ACCTACACCG AACTGAGATA CCTACAGCGT GAGCTATGAG AAAGCGCCAC GCTTCCCGAA	
2221	GGGAGAAAGG CGGACAGGTA TCCGGTAAGC GGCAGGGTCG GAACAGGAGA GCGCACGAGG	
2281	GAGCTTCCAG GGGGAAACGC CTGGTATCTT TATAGTCCTG TCGGGTTTCG CCACCTCTGA	
2341	CTTGAGCGTC GATTTTGTG ATGCTCGTCA GGGGGGCGGA GCCTATGGAA AAACGCCAGC	
2401	AACGCGGCCT TTTTACGGTT CCTGGCCTTT TGCTGGCCTT TGCTCACAT GTTCTTTCCT	
2461	GCGTTATCCC CTGATTCTGT GGATAACCGT ATTACCGCTA GCATGGATCT CGGGGACGTC	
2521	TAATACTAA GCGAGAGTAG GGAAGTCCA GGCATCAAAT AAAACGAAAG GCTCAGTCGG	
2581	AAGACTGGGC CTTTCGTTTT ATCTGTTGTT TGTCGGTGAA CGCTCTCCTG AGTAGGACAA	
2641	ATCCGCCGGG AGCGGATTTG AACGTTGTGA AGCAACGGCC CGGAGGGTGG CGGGCAGGAC	
2701	GCCCGCCATA AACTGCCAGG CATCAAATA AGCAGAAGGC CATC	

FIGURE 20B

Figure 2: pDEST1 Native Protein Expression in E. coli

-35 Tre promoter -10 RNA
 1 atgagctggt gacaattaat catccggctc gtataatgtg tggattgtg agcggataac
 tactcgacha ctgtaatta gtaggccgag catattacac accttaaacac tcgcctattg
 61 aatttcacac aggaacacaga caggtatagg atcacaagtt ~~tgtatdaaa~~ ~~agctgaacga~~
 ttaaagtgtg tcctttgtct gtccatatcc taggttcaa acatgtttt ~~tcgacttgc~~



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pDEST1 6464 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
216..257		Trc promoter
397..273		attR1
647..1306		CmR
1426..1510		inactivated ccdA
1648..1953		ccdB
1994..2118		attR2
2598..3503		ampR
4104..4264		ori
4504..4941		flori (f1 intergenic region)
5340..6420		lacIq

1	GTTTGACAGC	TTATCATCGA	CTGCACGGTG	CACCAATGCT	TCTGGCGTCA	GGCAGCCATC
61	GGAAGCTGTG	GTATGGCTGT	GCAGGTCGTA	AATCACTGCA	TAATTCGTGT	CGCTCAAGGC
121	GCACTCCCGT	TCTGGATAAT	GTTTTTTGCG	CCGACATCAT	AACGGTTCTG	GCAAATATTC
181	TGAAATGAGC	TGTTGACAAT	TAATCATCCG	GTCCGTATAA	TCTGTGGAAT	TGTGAGCGGG
241	ATAACAATTT	CATCGCGAGG	TACCAAGCTA	TCACAAGTTT	GTACAAAAAA	GCTGAACGAG
301	AAACGTAAAA	TGATATAAAT	ATCAATATAT	TAAATTAGAT	TTTGCATAAA	AAACAGACTA
361	CATAATACTG	TAAAACACAA	CATATCCAGT	CACTATGGCG	GCCGCTAAGT	TGGCAGCATC
421	ACCCGACGCA	CTTTGCGCCG	AATAAATACC	TGTGACGGAA	GATCACTTCG	CAGAATAAAT
481	AAATCCTGGT	GTCCCTGTTG	ATACCGGGAA	GCCCTGGGCC	AACTTTTGGC	GAAAAATGAGA
541	CGTTGATCGG	CACGTAAGAG	GTTCCAACCT	TCACCATAAT	GAAATAAGAT	CACTACCGGG
601	CGTATTTTTT	GAGTTATCGA	GATTTTCAGG	AGCTAAGGAA	GCTAAAATGG	AGAAAAAAT
661	CACTGGATAT	ACCACCGTTG	ATATATCCCA	ATGGCATCGT	AAAGAACATT	TTGAGGCATT
721	TCAGTCAGTT	GCTCAATGTA	CCTATAACCA	GACCGTTCAG	CTGGATATTA	CGGCCCTTTT
781	AAAGACCGTA	AAGAAAAATA	AGCACAAAGT	TTATCCGGCC	TTTATTACAA	TTCTTGCCCG
841	CCTGATGAAT	GCTCATCCGG	AATTCGGTAT	GGCAATGAAA	GACGGTGAGC	TGGTGATATG
901	GGATAGTGTT	CACCCTTGTT	ACACCGTTTT	CCATGAGCAA	ACTGAAACGT	TTTCATCGCT
961	CTGGAGTGAA	TACCACGACG	ATTTCCGGCA	GTTTCTACAC	ATATATTGCG	AAGATGTGGC
1021	GTGTTACGGT	GAAAAACCTG	CCTATTTCCC	TAAAGGGTTT	ATTGAGAATA	TGTTTTTCGT
1081	CTCAGCCAAT	CCCTGGGTGA	GTTTCACCAG	TTTTGATTTA	AACGTGGCCA	ATATGGACAA
1141	CTTCTTCGCC	CCCGTTTTCA	CCATGGGCAA	ATATTATACG	CAAGGCGACA	AGGTGCTGAT
1201	GCCGCTGGCG	ATTCAGGTTC	ATCATGCCGT	CTGTGATGGC	TTCCATGTCG	GCAGAATGCT
1261	TAATGAATTA	CAACAGTACT	GCGATGAGTG	GCAGGGCGGG	GCGTAAACGC	GTGGATCCGG
1321	CTTACTAAAA	GCCAGATAAC	AGTATGCGTA	TTTGCGCGCT	GATTTTTGCG	GTATAAGAA
1381	ATATACTGAT	ATGTATACCC	GAAGTATGTC	AAAAAGAGGT	GTGCTATGAA	GCAGCGTATT
1441	ACAGTGACAG	TTGACAGCGA	CAGCTATCAG	TTGCTCAAGG	CATATATGAT	GTCAATATCT
1501	CCGGTCTGGT	AAGCACAACC	ATGCAGAATG	AAGCCCGTCG	TCTGCGTGCC	GAACGCTGGA
1561	AAGCGGAAAA	TCAGGAAGGG	ATGGCTGAGG	TCGCCCGGTT	TATTGAAATG	AACGGCTCTT
1621	TTGCTGACGA	GAACAGGGAC	TGGTGAAATG	CAGTTTAAAG	TTTACACCTA	TAAAAGAGAG
1681	AGCCGTTATC	GTCTGTTTGT	GGATGTACAG	AGTGATATTA	TTGACACGCC	CGGGCGACGG
1741	ATGGTGATCC	CCCTGGCCAG	TGCACGCTCG	CTGTCAGATA	AAGTCTCCCG	TGAACCTTAC
1801	CCGGTGGTGC	ATATCGGGGA	TGAAAGCTGG	CGCATGATGA	CCACCGATAT	GGCCAGTGTC
1861	CCGGTCTCCG	TTATCGGGGA	AGAAGTGGCT	GATCTCAGCC	ACCGCGAAAA	TGACATCAAA
1921	AACGCCATTA	ACCTGATGTT	CTGGGGAATA	TAAATGTCAG	GCTCCCTTAT	ACACAGCCAG
1981	TCTGCAGGTC	GACCATAGTG	ACTGGATATG	TTGTGTTTTA	CAGTATTATG	TAGTCTGTTT
2041	TTTATGCAAA	ATCTAATTTA	ATATATTGAT	ATTTATATCA	TTTTACGTTT	CTCGTTCAGC
2101	TTTCTTGTTAC	AAAGTGGTGA	TAGCTTGGCT	GTTTTGGCGG	ATGAGAGAAG	ATTTTCAGCC
2161	TGATACAGAT	TAAATCAGAA	CGCAGAAGCG	GTCTGATAAA	ACAGAATTTG	CCTGGCGGCA
2221	GTAGCGCGGT	GGTCCCACCT	GACCCCATGC	CGAACTCAGA	AGTGAACGCG	CGTAGCGCCG
2281	ATGGTAGTGT	GGGGTCTCCC	CATGCGAGAG	TAGGGAACTG	CCAGGCATCA	AATAAAACGA
2341	AAGGCTCAGT	CGAAAGACTG	GGCCTTTCGT	TTTATCTGTT	GTTTGTGCGT	GAACGCTCTC
2401	CTGAGTAGGA	CAAATCCGCC	GGGAGCGGAT	TTGAACGTTG	CGAAGCAACG	GCCCGGAGGG
2461	TGGCGGGCAG	GACGCCGCCG	ATAAAGTCCC	AGGCATCAAA	TTAAGCAGAA	GGCCATCCTG
2521	ACGGATGGCC	TTTTTGCGTT	TCTACAAACT	CTTTTTGTTT	ATTTTCTTAA	ATACATTCAA-

FIGURE 21B

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2581 ATATGTATCC GCTCATGAGA CAATAACCCCT GATAAATGCT TCAATAATAT TGAAAAAGGA
2641 AGAGTATGAG TATTCAACAT TTCCGTGTGCG CCCTTATTCC CTTTTTTGCG GCATTTTGCC
2701 TTCCTGTTTT TGCTCACCCA GAAACGCTGG TGAAAGTAAA AGATGCTGAA GATCAGTTGG
2761 GTGCACGAGT GGGTTACATC GAACTGGATC TCAACAGCGG TAAGATCCTT GAGAGTTTTT
2821 GCCCCGAAGA ACGTTTTCCA ATGATGAGCA CTTTTAAAGT TCTGCTATGT GGCGCGGTAT
2881 TATCCCGTGT TGACGCCGGG CAAGAGCAAC TCGGTGCGCG CATACTAT TCTCAGAATG
2941 ACTTGGTTGA GTACTACCA GTCACAGAAA AGCATCTTAC GGATGGCATG ACAGTAAGAG
3001 AATTATGCAG TGCTGCCATA ACCATGAGTG ATAACACTGC GGCCAACCTA CTTCTGACAA
3061 CGATCGGAGG ACCGAAGGAG CTAACCGCTT TTTTGACAA CATGGGGGAT CATGTAACCTC
3121 GCCTTGATCG TTGGGAACCG GAGCTGAATG AAGCCATACC AAACGACGAG CGTGACACCA
3181 CGATGCCTAC AGCAATGGCA ACAACGTTGC GCAAACCTATT AACTGGCGAA CTACTTACTC
3241 TAGCTTCCCG GCAACAATTA ATAGACTGGA TGGAGCGCGA TAAAGTTGCA GGACCACTTC
3301 TGCGCTCGGC CCTTCCGGCT GGCTGGTTTA TTGCTGATAA ATCTGGAGCC GGTGAGCGTG
3361 GGTCTCGCGG TATCATTGCA GCACTGGGGC CAGATGGTAA GCCCTCCCGT ATCGTAGTTA
3421 TCTACACGAC GGGGAGTCAG GCAACTATGG ATGAACGAAA TAGACAGATC GCTGAGATAG
3481 GTGCCTCACT GATTAAAGCAT TGGTAACTGT CAGACCAAGT TTACTCATAT ATACTTTAGA
3541 TTGATTTAAA ACTTCATTTT TAATTAAAAA GGATCTAGGT GAAGATCCTT TTTGATAATC
3601 TCATGACCAA AATCCCTTAA CGTGAGTTTT CGTTCCACTG AGCGTCAGAC CCCGTAGAAA
3661 AGATCAAAGG ATCTTCTTGA GATCCTTTTT TTCTGCGCGT AATCTGCTGC TTGCAAACAA
3721 AAAAACCACC GCTACCAGCG GTGGTTTGTG TGCCGGATCA AGAGCTACCA ACTCTTTTTT
3781 CGAAGGTAAC TGGCTTCAGC AGAGCGCAGA TACCAAATAC TGTCCTTCTA GTGTAGCCGT
3841 AGTTAGGCCA CCACTTCAAG AACTCTGTAG CACCGCCTAC ATACCTCGCT CTGCTAATCC
3901 TGTTACCAGT GGCTGCTGCC AGTGGCGATA AGTCGTGTCT TACCGGGTTG GACTCAAGAC
3961 GATAGTTACC GGATAAGGCG CAGCGGTGCG GCTGAACGGG GGGTTCGTGC ACACAGCCCA
4021 GCTTGGAGCG AACGACCTAC ACCGAACCTGA GATACCTACA GCGTGAGCTA TGAGAAAGCG
4081 CCACGCTTCC CGAAGGGAGA AAGGCGGACA GGTATCCGGT AAGCGGCAGG GTCGGAACAG
4141 GAGAGCGCAC GAGGGAGCTT CCAGGGGGA ACGCCTGGTA TCTTTATAGT CCTGTGCGGT
4201 TTCGCCACCT CTGACTTGAG CGTCGATTTT TGTGATGCTC GTCAGGGGGG CGGAGCCTAT
4261 GCAAAAACGC CAGCAACGCG GCCTTTTTAC GGTTCCTGGC CTTTGTCTGG CCTTTTGCTC
4321 ACATGTTCTT TCCTGCGTTA TCCCCTGATT CTGTGGATAA CCGTATTACC GCCTTTGAGT
4381 GAGCTGATAC CGCTCGCCGC AGCCGAACGA CCGAGCGCAG CGAGTCAGTG AGCGAGGAAG
4441 CGGAAGAGCG CCTGATGCGG TATTTTCTCC TTACGCATCT GTGCGGTATT TCACACCGCA
4501 TAATTTTGTG AAAATTCGCG TTAAATTTTT GTTAAATCAG CTCATTTTTT AACCAATAGG
4561 CCGAAATCGG CAAAATCCCT TATAAATCAA AAGAATAGAC CGAGATAGGG TTGAGTGTG
4621 TTCCAGTTTG GAACAAGAGT CCACTATTAA AGAACGTGGA CTCCAACGTC AAAGGGCGAA
4681 AAACCGTCTA TCAGGGCGAT GGCCCACTAC GTGAACCATC ACCCTAATCA AGTTTTTTGG
4741 GGTCTGAGGTG CCGTAAAGCA CTAAATCGGA ACCCTAAAGG GAGCCCCCGA TTTAGAGCTT
4801 GACGGGGGAAA GCCGGCGAAC GTGGCGGAAA AGGAAGGGA GAAAGCGAAA GGAGCGGGCG
4861 CTAGGGCGCT GGCAAGTGTA GCGGTCACGC TCGCGGTAA CACCACACCC GCCGCGCTTA
4921 ATGCGCCGCT ACAGGGCGCG TCCATTGCGC ATTCAGGCTG CTATGGTGCA CTCTCAGTAC
4981 AATCTGCTCT GATGCCGCAT AGTTAAGCCA GTACCACTCA CGTAGCGATA TCGGAGTGTA
5041 TACACTCCGC TATCGCTACG TGAATGGGTC ATGGCTGCGC CCCGACACCC GCCAACACCC
5101 GCTGACGCGC CCTGACGGGC TTGTCTGCTC CCGGCATCCG CTTACAGACA AGCTGTGACC
5161 GTCTCCGGGA GCTGCATGTG TCAGAGGTTT TCACCGTCAT CACCGAAACG CGCGAGGCAG
5221 CAGATCAATT CGCGCGCGAA GGCGAAGCGG CATGCATTTA CGTTGACACC ATCGAATGGT
5281 GCAAAAACCTT TCGCGGTATG GCATGATAGC GCCCGGAAGA GAGTCAATTG AGGGTGGTGA
5341 ATGTGAAACC AGTAACGTTA TACGATGTCG CAGAGTATGC CGGTGTCTCT TATCAGACCG
5401 TTTCCCGCGT GGTGAACCAG GCCAGCCACG TTTCTGCGAA AACGCGGGAA AAAGTGGAAG
5461 CGGCGATGGC GGAGCTGAAT TACATTCCCA ACCGCGTGGC ACAACAACCT GCGGGCAAAC
5521 AGTCGTTGCT GATTGGCGTT GCCACCTCCA GTCTGGCCCT GCACGCGCCG TCGCAAATTG
5581 TCGCGCGGAT TAAATCTCGC GCCGATCAAC TGGGTGCCAG CGTGGTGGTG TCGATGGTAG
5641 AACGAAGCGG CGTCGAAGCC TGTAAGCGG CGGTGCACAA TCTTCTCGCG CAACGCGTCA
5701 GTGGGCTGAT CATTAACTAT CCGCTGGATG ACCAGGATGC CATTGCTGTG GAAGCTGCCT
5761 GCACTAATGT TCCGGCGTTA TTTCTTGATG TCTCTGACCA GACACCCATC AACAGTATTA
5821 TTTTCTCCCA TGAAGACGGT ACGCGACTGG GCGTGGAGCA TCTGGTCGCA TTGGGTCAAC
5881 AGCAAATCGC GCTGTAGCG GGCCCATTA GTTCTGTCTC GGCGCGTCTG CGTCTGGCTG
5941 GCTGGCATAA ATATCTCACT CGCAATCAAA TTCAGCCGAT ACGGGAACGG GAAGGCGACT
6001 GGAGTGCCAT GTCCGGTTTT CAACAAACCA TGCAAATGCT GAATGAGGGC ATCGTTCCCA-

FIGURE 21C

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6061 CTGCGATGCT GGTGCGCAAC GATCAGATGG CGCTGGGCGC AATGCGCGCC ATTACCGAGT
6121 CCGGGCTGCG CGTTGGTGCG GATATCTCGG TAGTGGGATA CGACGATACC GAAGACAGCT
6181 CATGTTATAT CCCGCCGTTA ACCACCATCA AACAGGATTT TCGCCTGCTG GGGCAAACCA
6241 GCGTGGACCG CTTGCTGCAA CTCTCTCAGG GCCAGGCGGT GAAGGGCAAT CAGCTGTTGC
6301 CCGTCTCACT GGTGAAAAGA AAAACCACCC TGGCACCCAA TACGCAAACC GCCTCTCCCC
6361 GCGCGTTGGC CGATTCAATTA ATGCAGCTGG CACGACAGGT TTCCCGACTG GAAAGCGGGC
6421 AGTGAGCGCA ACGCAATTAA TGTGAGTTAG CGCGAATTGA TCTG

FIGURE 21D

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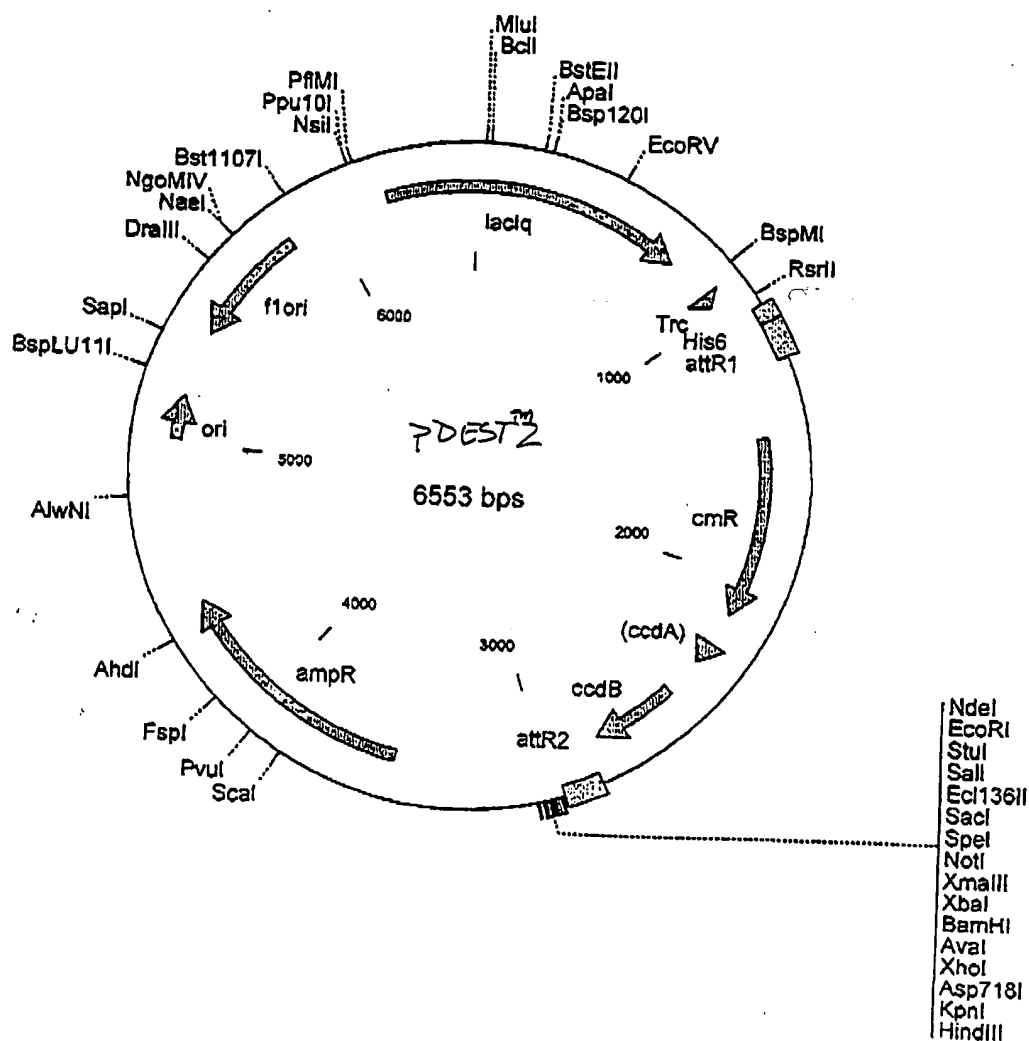
Figure 22A: pDEST2

His6 fusions in E. coli

970 aat att ctg aaa tga gct ggt gac aat ⁻³⁵ tad tca tcc ggt ccg ⁻¹⁰ tat aat ctg
 tta taa gac ttt act cga caa ctg tta att agt agg cca ggc ata tta gac

1021 tgg aat tgt gag cgg ata aca att tca cac agg aaa cag acc ^{Met Ser Tyr} atg tcc cgc
 acc tta aca ctc gcc tat tgt taa agt gtg tcc ttt gtc tgg tac agc atg

1072 ^{Tyr His His His His His His} tac cat cac cat cac cat cat ^{Glu} ggt atc ^{Tyr} aca agt ^{Tyr} tgg tgg ^{attR1} aca gca gcy gaa
 atg gta gtg gta gtg gta gtg ccg tag tgt tca aac atg ttt ctt cga cgt



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pDEST2 6553 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
912..962		Trc
1223..1009		attR1
1473..2132		CmR
2252..2336		inactivated ccdA
2474..2779		ccdB
2820..2944		attR2
3509..4414		ampR
5015..5175		ori
5415..5852		flori (f1 intergenic region)
6225..752		lacIq

1	GGCGGTGCAC	AATCTTCTCG	CGCAACGCGT	CAGTGGGCTG	ATCATTAACT	ATCCGCTGGA
61	TGACCAGGAT	GCCATTGCTG	TGGAAGCTGC	CTGCACTAAT	GTTCCGGCGT	TATTTCTTGA
121	TGTCTCTGAC	CAGACACCCA	TCAACAGTAT	TATTTTCTCC	CATGAAGACG	GTACGCGACT
181	GGCGGTGGAG	CATCTGGTGC	CATTGGGTCA	CCAGCAAATC	GCGCTGTTAG	CGGGCCCATT
241	AAGTTCTGTG	TCGGCGCGTC	TGCGTCTGGC	TGGCTGGCAT	AAATATCTCA	CTCGCAATCA
301	AATTCAGCCG	ATAGCGGAAC	GGGAAGGCGA	CTGGAGTGCC	ATGTCCGGTT	TTCAACAAAC
361	CATGCAAATG	CTGAATGAGG	GCATCGTTCC	CACTGCGATG	CTGGTTGCCA	ACGATCAGAT
421	GGCGCTGGGC	GCAATGCGCG	CCATTACCGA	GTCCGGGCTG	CGCGTTGGTG	CGGATATCTC
481	GGTAGTGGGA	TACGACGATA	CCGAAGACAG	CTCATGTTAT	ATCCCGCCGT	CAACCACCAT
541	CAAACAGGAT	TTTCGCCTGC	TGGGGCAAAC	CAGCGTGGAC	CGCTTGCTGC	AACTCTCTCA
601	GGGCCAGGCG	GTGAAGGGCA	ATCAGCTGTT	GCCCGTCTCA	CTGGTGAAAA	GAAAAACCAC
661	CCTGGCACCC	AATACGCAAA	CCGCCTCTCC	CCGCGCGTTG	GCCGATTCAT	TAATGCAGCT
721	GGCACGACAG	GTTTCCCGAC	TGGAAAGCGG	GCAGTGAGCG	CAACGCAATT	AATGTGAGTT
781	AGCGCGAATT	GATCTGGTTT	GACAGCTTAT	CATCGACTGC	ACGGTGCACC	AATGCTTCTG
841	GCGTCAGGCA	GCCATCGGAA	GCTGTGGTAT	GGCTGTGCAG	GTCGTAAATC	ACTGCATAAT
901	TCGTGTCGCT	CAAGGCGCAC	TCCCGTTCGT	GATAATGTTT	TTTGCGCCGA	CATCATAACG
961	GTTCTGGCAA	ATATTCTGAA	ATGAGCTGTT	GACAATTAAT	CATCCGGTCC	GTATAATCTG
1021	TGGAATTGTG	AGCGGATAAC	AATTTACAC	AGGAAACAGA	CCATGTCGTA	CTACCATCAC
1081	CATCACCATC	ACGGCATCAC	AAGTTTGTAC	AAAAAAGCTG	AACGAGAAAC	GTAAAATGAT
1141	ATAAATATCA	ATATATTAAT	TTAGATTTTG	CATAAAAAAC	AGACTACATA	ATACTGTAAA
1201	ACACAACATA	TCCAGTCACT	ATGGCGGCCG	CTAAGTTGGC	AGCATCACCC	GACGCACTTT
1261	GCGCCGAATA	AATACCTGTG	ACGGAAGATC	ACTTCGCAGA	ATAAATAAAT	CCTGGTGTCC
1321	CTGTTGATAC	CGGGAAGCCC	TGGGCCAACT	TTTGGCGAAA	ATGAGACGTT	GATCGGCACG
1381	TAAGAGGTTC	CAACTTTCAC	CATAATGAAA	TAAGATCACT	ACCGGGCGTA	TTTTTTGAGT
1441	TATCGAGATT	TTCAGGAGCT	AAGGAAGCTA	AAATGGAGAA	AAAAATCACT	GGATATACCA
1501	CCGTTGATAT	ATCCCAATGG	CATCGTAAAG	AACATTTTGA	GGCATTTTCG	TCAGTTGCTC
1561	AATGTACCTA	TAACCAGACC	GTTTCAGCTG	ATATTACGGC	CTTTTTAAAG	ACCGTAAAGA
1621	AAAATAAGCA	CAAGTTTAT	CCGGCCTTTA	TTCACATTCT	TGCCCCGCTG	ATGAATGCTC
1681	ATCCGGAATT	CCGTATGGCA	ATGAAAGACG	GTGAGCTGGT	GATATGGGAT	AGTGTTCCAC
1741	CTTGTTACAC	CGTTTCCAT	GAGCAAACCTG	AAACGTTTTTC	ATCGCTCTGG	AGTGAATACC
1801	ACGACGATTT	CCGSCAGTTT	CTACACATAT	ATTGCAAGA	TGTGGCGTGT	TACGGTGAAG
1861	ACCTGGCCTA	TTTCCCTAAA	GGGTTTATTG	AGAATATGTT	TTTCGTCTCA	GCCAATCCCT
1921	GGGTGAGTTT	CACCAAGTTT	GATTTAAACG	TGGCCAATAT	GGACAACTTC	TTCCGCCCCG
1981	TTTTCACCAT	GGGCAAATAT	TATACGCAAG	GCGACAAGGT	GCTGATGCCG	CTGGCGATTG
2041	AGGTTTCATCA	TGCGCTCTGT	GATGGCTTCC	ATGTCGGCAG	AATGCTTAAT	GAATTACAAC
2101	AGTACTGCGA	TGAGTGGCAG	GGCGGGGCGT	AAACGCGTGG	ATCCGGCTTA	CTAAAAGCCA
2161	GATAACAGTA	TGCGTATTTG	CGCGCTGATT	TTTGGCGTAT	AAGAATATAT	ACTGATATGT
2221	ATACCCGAAG	TATGTCAAAA	AGAGGTGTGC	TATGAAGCAG	CGTATTACAG	TGACAGTTGA
2281	CAGCGACAGC	TATCAGTTGC	TCAAGGCATA	TATGATGTCA	ATATCTCCGG	TCTGGTAAGC
2341	ACAACCATGC	AGAATGAAGC	CCGTGCTCTG	CGTGCCGAAC	GCTGGAAAGC	GGAAAATCAG
2401	GAAGGGATGG	CTGAGGTCGC	CCGGTTTATT	GAAATGAACG	GCTCTTTTGC	TGACGAGAAC
2461	AGGGACTGGT	GAAATGCAGT	TTAAGGTTTA	CACCTATAAA	AGAGAGAGCC	GTTATCGTCT
2521	GTTTGTGGAT	GTACAGAGTG	ATATTATTGA	CACGCCCGGG	CGACGGATGG	TGATCCCCCT-

FIGURE 22B

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2581 GGCCAGTGCA CGTCTGCTGT CAGATAAAGT CTCCCCTGAA CTTTACCCGG TGGTGCATAT
2641 CGGGGATGAA AGCTGGCGCA TGATGACCAC CGATATGGCC AGTGTGCCGG TCTCCGTTAT
2701 CGGGGAAGAA GTGGCTGATC TCAGCCACCG CGAAAATGAC ATCAAAAACG CCATTAACCT
2761 GATGTTCTGG GGAATATAAA TGTCAGGCTC CCTTATACAC AGCCAGTCTG CAGGTCGACC
2821 ATAGTGA CTG GATATGTTGT GTTTTACAGT ATTATGTAGT CTGTTTTTTA TGCAAAATCT
2881 AATTTAATAT ATTGATATTT ATATCATTTT ACGTTTCTCG TTCAGCTTTC TTGTACAAAG
2941 TGGTGATGCC CATATGGGAA TTCAAAGGCC TACGTCGACG AGCTCACTAG TCGCGGCCGC
3001 TTCTAGAGGA TCCCTCGAGG CATGCGGTAC CAAGCTTGGC TGTTTTGGCG GATGAGAGAA
3061 GATTTTCAGC CTGATACAGA TTAAATCAGA ACGCAGAAGC GGTCTGATAA AACAGAATTT
3121 GCGTGGCGGC AGTAGCGCGG TGGTCCCACG TGACCCCATG CCGAACTCAG AAGTGAACCG
3181 CCGTAGCGCC GATGGTAGTG TGGGGTCTCC CCATGCGAGA GTAGGGAACG GCCAGGCATC
3241 AAATAAAACG AAAGGCTCAG TCGAAAGACT GGGCCTTTTCG TTTTATCTGT TGTTTGTGCG
3301 TGAACGCTCT CCTGAGTAGG ACAAATCCGC GGGGAGCGGA TTTGAACGTT GCGAAGCAAC
3361 GGCCCGGAGG GTGGCGGGCA GGACGCCCCG CATAAACTGC CAGGCATCAA ATTAAGCAGA
3421 AGGCCATCCT GACGGATGGC CTTTTTGCGT TTCTACAAAC TCTTTTTGTT TATTTTTCTA
3481 AATACATTCA AATATGTATC CGCTCATGAG ACAATAACCC TGATAAATGC TTCAATAATA
3541 TTGAAAAAGG AAGAGTATGA GTATTCAACA TTTCCGTGTC GCCCTTATTC CTTTTTTTGC
3601 GGCATTTTGC CTTCTGTTT TTGCTCACC AGAAACGCTG GTGAAAGTAA AAGATGCTGA
3661 AGATCAGTTG GGTGCACGAG TGGGTTACAT CGAACTGGAT CTCAACAGCG GTAAGATCCT
3721 TGAGAGTTTT CGCCCCGAAG AACGTTTTTC AATGATGAGC ACTTTTAAAG TTCTGCTATG
3781 TGGCGCGGTA TTATCCCGTG TTGACGCCGG GCAAGAGCAA CTCGGTCGCC GCATACACTA
3841 TTCTCAGAAT GACTTGGTTG AGTACTCACC AGTCACAGAA AAGCATCTTA CGGATGGCAT
3901 GACAGTAAGA GAATTATGCA GTGCTGCCAT AACCATGAGT GATAAACTG CGGCCAACTT
3961 ACTTCTGACA ACGATCGGAG GACCGAAGGA GCTAACCGCT TTTTTCACA ACATGGGGGA
4021 TCATGTAACG CGCCTTGATC GTTGGGAACC GGAGCTGAAT GAAGCCATAC CAAACGACGA
4081 GCGTGACACC ACGATGCCTA CAGCAATGGC AACAACGTTG CGCAAACAT TAAC TGCGGA
4141 ACTACTTACT CTAGCTTCCC GGCAACAATT AATAGACTGG ATGGAGGCGG ATAAAGTTGC
4201 AGGACCACTT CTGCGCTCGG CCCTTCCGGC TGGCTGGTTT ATTGCTGATA AATCTGGAGC
4261 CGGTGAGCGT GGGTCTCGCG GTATCATTGC AGCACTGGGG CCAGATGGTA AGCCCTCCCG
4321 TATCGTAGTT ATCTACACGA CGGGGAGTCA GGCAACTATG GATGAACGAA ATAGACAGAT
4381 CGCTGAGATA GGTGCCTCAC TGATTAAGCA TTGGTAACTG TCAGACCAAG TTTACTCATA
4441 TATACTTTAG ATTGATTTAA AACTTCATTT TTAATTTAAA AGGATCTAGG TGAAGATCCT
4501 TTTTGATAAT CTCATGACCA AAATCCCTTA ACGTGAGTTT TCGTTCCACT GAGCGTCAGA
4561 CCCCCTAGAA AAGATCAAAG GATCTTCTTG AGATCCTTTT TTTCTGCGCG TAATCTGCTG
4621 CTTGCAACA AAAAAACCAC CGCTACCAGC GGTGGTTTGT TTGCCGGATC AAGAGCTACC
4681 AACTCTTTTT CCGAAGGTAA CTGGCTTACG CAGAGCGCAG ATACCAAATA CTGTCTTCT
4741 AGTGTAGCCG TAGTTAGGCC ACCACTCTAA GAACCTCTGA GCACCGCTA CATACTCGC
4801 TCTGCTAATC CTGTTACCAG TGGCTGCTGC CAGTGCGGAT AAGTCGTGTC TTACCGGTT
4861 GGA CTCAAGA CGATAGTTAC CGGATAAGGC GCAGCGGTG GGTGAACGG GGGGTTCTG
4921 CACACAGCCC AGCTTGGAGC GAACGACCTA CACCGAACTG AGATACCTAC AGCGTGAGCT
4981 ATGAGAAAGC GCCACGCTTC CCGAAGGGAG AAAGGCGGAC AGGTATCCGG TAAGCGGCAG
5041 GGTGCGAACA GGAGAGCGCA CGAGGGAGCT TCCAGGGGGA AACGCCTGGT ATCTTTATAG
5101 TCCTGTGCGG TTTGCGCCACC TCTGACTTGA GCGTCGATTT TTGTGATGCT CGTCAGGGGG
5161 GCGGAGCCTA TGGAAAAACG CCAGCAACGC GGCCTTTTTC CGGTTCTGCG CTTTTTGCTG
5221 GCCTTTTGCT CACATGTTCT TTCCTGCGTT ATCCCTGAT TCTGTGGATA ACCGTATTAC
5281 CGCCTTTGAG TGAGCTGATA CCGCTCGCG CAGCCGAACG ACCGAGCGCA GCGAGTCAGT
5341 GAGCGAGGAA GCGGAAGAGC GCCTGATGCG GTATTTTCTC CTTACGCATC TGTGCGGTAT
5401 TTCACACCGC ATAATTTTGT TAAATTCGC GTTAAATTTT TGTAAATCA GCTCATTTTT
5461 TAACCAATAG GCCGAAATCG GCAAAATCCC TTATAAATCA AAAGAATAGA CCGAGATAGG
5521 GTTGAGTGTT GTTCCAGTTT GGAACAAGAG TCCACTATTA AAGAACGTGG ACTCCAACGT
5581 CAAAGGGCGA AAAACCGTCT ATCAGGGCGA TGGCCCACTA CGTGAACCAT CACCCTAATC
5641 AAGTTTTTTG GGGTCGAGGT GCCGTAAAGC ACTAAATCGG AACCTAAAG GGAGCCCCCG
5701 ATTTAGAGCT TGACGGGGAA AGCCGGCGAA CGTGCGGAGA AAGGAAGGGA AGAAAGCGAA
5761 AGGAGCGGGC GCTAGGGCGC TGGCAAGTGT AGCGGTCACG CTGCGCGTAA CCACCACACC
5821 CGCCGCGCTT AATGCGCCGC TACAGGGCGC GTCCCATTCG CCATTCAGG TGCTATGGTG
5881 CACTCTCAGT ACAATCTGCT CTGATGCCGC ATAGTTAAGC CAGTATACAC TCCGCTATCG
5941 CTACGTGACT GGGTCATGCG TGCGCCCCGA CACCCGCCAA CACCCGCTGA CGCGCCCTGA
6001 CGGGCTTGTC TGCTCCCGGC ATCCGCTTAC AGACAAGCTG TGACCGTCTC CGGGAGCTGC-

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FIGURE 22C

6061 ATGTGTCAGA GGTTTTCCACC GTCATCACCG AAACGCGCGA GGCAGCAGAT CAATTCGCGC
6121 GCGAAGGCGA AGCGGCATGC ATTTACGTTG ACACCATCGA ATGGTGCAA ACCTTTCGCG
6181 GTATGGCATG ATAGCGCCCG GAAGAGAGTC AATTCAGGGT GGTGAATGTG AAACCAGTAA
6241 CGTTATACGA TGTCGCAGAG TATGCCGGTG TCTCTTATCA GACCGTTTCC CGCGTGGTGA
6301 ACCAGGCCAG CCACGTTTCT GCGAAAACGC GGGAAAAAGT GGAAGCGGCG ATGGCGGAGC
6361 TGAATTACAT TCCCAACCGC GTGGCACAAC AACTGGCGGG CAAACAGTCG TTGCTGATTG
6421 GCGTTGCCAC CTCCAGTCTG GCCCTGCACG CGCCGTCGCA AATTGTCGCG GCGATTAAAT
6481 CTCGCGCCGA TCAACTGGGT GCCAGCGTGG TGGTGTGAT GGTAGAACGA AGCGGCGTCG
6541 AAGCCTGTAA AGC

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Figure 23A: pDEST3

GST fusions in E. coli

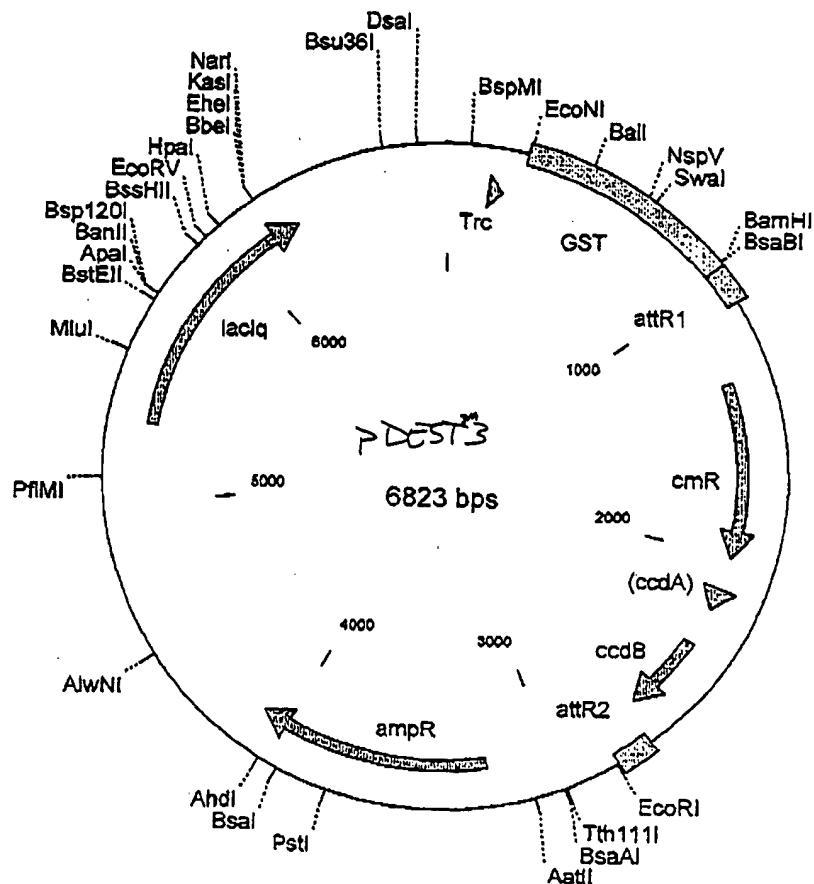
154 cgg ttc tgg caa ata ttc tga aat gag ctg ⁻³⁵ ttg aca att aat cat cgg ctc
 gcc aag acc gtt tat aag act tta ctc gac ⁻¹⁰ aac tgt taa tta gta gcc gag

205 gca taa tgt gtg gaa ttg tga gcg gat aac aat ttc aca cag gaa aca gta
 cat att aca cac ctt aac act cgc cta ttg tta aag tgt gtc ctt tgt cat

256 M S P I L → GST / / / / /
 ttc atg tcc cct ata cta ggt tat tgg aaa att aag ggc ctt gtg caa ccc
 aag tac agg gga tat gat cca ata acc ttt taa ttc ccg gaa cac gtt ggg

919 " GST → R G S R R A S V G S P S T S
 ctg gtt ccg cgt gga tct cgt cgt gca tct gtt gga tcc cca tca aca agt
 gac caa ggc gca cct aga gca gca cgt aga caa cct agg ggt agt tgt tca

970 ~~ttg tac aac aac gct gaa cga gaa acg taa aat gat ata aat aat aat ata~~
~~aac atg ttt ttc cga cct gct cct tgc att tta cta tat tta tag tta tat~~



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pDEST3 6823 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
150..200		Trc
1087..963		attR1
1337..1996		CmR
2116..2200		inactivated ccdA
2338..2643		ccdB
2684..2808		attR2
3231..4091		ampR
5295..6254		lacIq

1	ACGTTATCGA	CTGCACGGTG	CACCAATGCT	TCTGGCGTCA	GGCAGCCATC	GGAAGCTGTG
61	GTATGGCTGT	GCAGGTCGTA	AATCACTGCA	TAATTCGTGT	CGCTCAAGGC	GCACTCCCGT
121	TCTGGATAAT	GTTTTTTGCG	CCGACATCAT	AACGGTTCTG	GCAAATATTC	TGAAATGAGC
181	TGTTGACAAT	TAATCATCGG	CTCGTATAAT	GTGTGGAATT	GTGAGCGGAT	AACAATTTCA
241	CACAGGAAAC	AGTATTCATG	TCCCCTATAC	TAGGTTATTG	GAAAATTAAG	GGCCTTGTGC
301	AACCCACTCG	ACTTCTTTTG	GAATATCTTG	AAGAAAAATA	TGAAGAGCAT	TTGTATGAGC
361	GCGATGAAGG	TGATAAATGG	CGAAACAAAA	AGTTTGAATT	GGGTTTGGAG	TTTCCCAATC
421	TTCTTTATTA	TATTGATGGT	GATGTTAAAT	TAACACAGTC	TATGGCCATC	ATACGTTATA
481	TAGCTGACAA	GCACAACATG	TTGGGTGGTT	GTCCAAAAGA	GCGTGCAGAG	ATTTCAATGC
541	TTGAAGGAGC	GGTTTGGAT	ATTAGATACG	GTGTTTCGAG	AATTGCATAT	AGTAAAGACT
601	TTGAAACTCT	CAAAGTTGAT	TTTCTTAGCA	AGCTACCTGA	AATGCTGAAA	ATGTTCTGAAG
661	ATCGTTTATG	TCATAAAACA	TATTTAAATG	GTGATCATGT	AACCCATCCT	GACTTCATGT
721	TGTATGACGC	TCTTGATGTT	GTTTTATACA	TGGACCCAAT	GTGCCTGGAT	GCGTTCCCAA
781	AATTAGTTTG	TTTTAAAAAA	CGTATTGAAG	CTATCCCACA	AATTGATAAG	TACTTGAAAT
841	CCAGCAAGTA	TATAGCATGG	CCTTTGCAGG	GCTGGCAAGC	CACGTTTGGT	GGTGGCGACC
901	ATCCTCCAAA	ATCGGATCTG	GTTCCGCGTG	GATCTCGTCG	TGCATCTGTT	GGATCCCCAT
961	CAACAAGTTT	GTACAAAAAA	GCTGAACGAG	AAACGTAAAA	TGATATAAAT	ATCAATATAT
1021	TAAATTAGAT	TTTGCATAAA	AAACAGACTA	CATAATACTG	TAAAACACAA	CATATCCAGT
1081	CACTATGGCG	GCCGCTAAGT	TGGCAGCATC	ACCCGACGCA	CTTTGCGCCG	AATAAATACC
1141	TGTGACGGAA	GATCACTTCG	CAGAATAAAT	AAATCCTGGT	GTCCCTGTTG	ATACCGGGAA
1201	GCCCTGGGCC	AACTTTTGGC	GAAAATGAGA	CGTTGATCGG	CACGTAAGAG	GTTCCAACCT
1261	TCACCATAAT	GAAATAAGAT	CACTACCGGG	CGTATTTTTT	GAGTTATCGA	GATTTTCAGG
1321	AGCTAAGGAA	GCTAAAAATG	AGAAAAAAAT	CACTGGATAT	ACCACCGTTG	ATATATCCCA
1381	ATGGCATCGT	AAAGAACATT	TTGAGGCATT	TCAGTCAGTT	GCTCAATGTA	CCTATAACCA
1441	GACCGTTTCAG	CTGGATATTA	CGGCCTTTTT	AAAGACCGTA	AAGAAAAATA	AGCACAAAGT
1501	TTATCCGGCC	TTTATTACAC	TTCTTGCCCG	CCTGATGAAT	GCTCATCCGG	AATTCCGTAT
1561	GGCAATGAAA	GACGGTGAGC	TGGTGATATG	GGATAGTGTT	CACCCCTTGT	ACACCGTTTT
1621	CCATGAGCAA	ACTGAAACGT	TTTCATCGCT	CTGGAGTGAA	TACCACGACG	ATTTCCGGCA
1681	GTTTCTACAC	ATATATTTCG	AAGATGTGGC	GTGTTACGGT	GAAAACCTGG	CCTATTTCCC
1741	TAAAGGGTTT	ATTGAGAATA	TGTTTTTCGT	CTCAGCCAAT	CCCTGGGTGA	GTTTCACCAG
1801	TTTTGATTTA	AACGTGGCCA	ATATGGACAA	CTTCTTCGCC	CCCGTTTTCA	CCATGGGCAA
1861	ATATTATACG	CAAGGCGACA	AGGTGCTGAT	GCCGCTGGCG	ATTCAGGTTT	ATCATGCCGT
1921	CTGTGATGGC	TTCCATGTCG	GCAGAAATGCT	TAATGAATTA	CAACAGTACT	GCGATGAGTG
1981	GCAGGGCGGG	GCGTAAAGAT	CTGGATCCGG	CTTACTAAAA	GCCAGATAAC	AGTATCCGTA
2041	TTTGC GCGCT	GATTTTTGCG	GTATAAGAAT	ATATACTGAT	ATGTATACCC	GAAGTATGTC
2101	AAAAAGAGGT	GTGCTATGAA	GCAGCGTATT	ACAGTGACAG	TTGACAGCGA	CAGCTATCAG
2161	TTGCTCAAGG	CATATATGAT	GTCAATATCT	CCGGTCTGGT	AAGCACAACC	ATGCAGAATG
2221	AAGCCCGTCG	TCTGCGTGCC	GAACGCTGGA	AAGCGGAAAA	TCAGGAAGGG	ATGGCTGAGG
2281	TCGCCCCGGT	TATTGAAATG	AACGGCTCTT	TTGCTGACGA	GAACAGGGAC	TGGTGAAATG
2341	CAGTTTAAGG	TTTACACCTA	TAAAAGAGAG	AGCCGTTATC	GTCTGTTTGT	GGATGTACAG
2401	AGTGATATTA	TTGACACGCC	CGGGCGACGG	ATGGTGATCC	CCCTGGCCAG	TGCACGCTCTG
2461	CTGTCAGATA	AAGTCTCCCG	TGAACTTTAC	CCGGTGGTGC	ATATCGGGGA	TGAAAGCTGG
2521	CGCATGATGA	CCACCGATAT	GGCCAGTGTG	CCGGTCTCCG	TTATCGGGGA	AGAAGTGGCT
2581	GATCTCAGCC	ACCGCGAAAA	TGACATCAAA	AACGCCATTA	ACCTGATGTT	CTGGGGAATA
2641	TAAATGTCAG	GCTCCCTTAT	ACACAGCCAG	TCTGCAGGTC	GACCATAGTG	ACTGGATATG-

FIGURE 23B

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2701 TTGTGTTTTA CAGTATTATG TAGTCTGTTT TTTATGCAAA ATCTAATTTA ATATATTGAT
 2761 ATTTATATCA TTTTACGTTT CTCGTTTCAGC TTTCTTGAC AAAGTGGTTG ATGGAATTC
 2821 ATCGTGA CTGACTG ACTGACGATC TGCCTCGCGC GTTTCGGTGA TGACGGTGAA AACCTCTGAC
 2881 ACATGCAGCT CCCGGAGACG GTCACAGCTT GTCTGTAAGC GGATGCCGGG AGCAGACAAG
 2941 CCCGTCAGGG CGCGTCAGCG GGTGTTGGCG GGTGTCGGGG CGCAGCCATG ACCCAGTCAC
 3001 GTAGCGATAG CGGAGTGAT AATTCTTGAA GACGAAAGGG CCTCGTGATA CGCCTATTTT
 3061 TATAGGTTAA TGTCATGATA ATAATGGTTT CTAGACGTC AGGTGGCACT TTTCCGGGAA
 3121 ATGTGCGCGG AACCCCTATT TGTTTATTTT TCTAAATACA TTCAAATATG TATCCGCTCA
 3181 TGAGACAATA ACCCTGATAA ATGCTTCAAT AATATTGAAA AAGGAAGAGT ATGAGTATTC
 3241 AACATTTCCG TGTCGCCCTT ATTCCCTTTT TTGCGGCATT TTGCCTTCCT GTTTTTGCTC
 3301 ACCCAGAAAC GCTGGTGAAA GTAAAAGATG CTGAAGATCA GTTGGGTGCA CGAGTGGGTT
 3361 ACATCGAACT GGATCTCAAC AGCGGTAAGA TCCTTGAGAG TTTTCGCCCC GAAGAACGTT
 3421 TTCCAATGAT GAGCACTTTT AAAGTTCTGC TATGTGGCGC GGTATTATCC CGTGTGACG
 3481 CCGGGCAAGA GCAACTCGGT CGCCGCATAC ACTATTCTCA GAATGACTTG GTTGAGTACT
 3541 CACCAGTCAC AGAAAAGCAT CTACGGATG GCATGACAGT AAGAGAATTA TGCAGTGCTG
 3601 CCATAACCAT GAGTGATAAC ACTGCGGCCA ACTTACTTCT GACAACGATC GGAGGACCGA
 3661 AGGAGCTAAC CGCTTTTTTG CACAACATGG GGGATCATGT AACTCGCCTT GATCGTTGGG
 3721 AACCAGAGCT GAATGAAGCC ATACCAAACG ACGAGCGTGA CACCACGATG CCTGCAGCAA
 3781 TGGCAACAAC GTTGCACAAA CTATTAACGT GCGAACTACT TACTCTAGCT TCCCGGCAAC
 3841 AATTAATAGA CTGGATGGAG GCGGATAAAG TTGCAGGACC ACTTCTGCGC TCGGCCCTTC
 3901 CGGCTGGCTG GTTTATTGCT GATAAATCTG GAGCCGGTGA GCGTGGGTCT CGCGGTATCA
 3961 TTGCAGCACT GGGGCCAGAT GGTAAGCCCT CCCGTATCGT AGTTATCTAC ACGACGGGGA
 4021 GTCAGGCAAC TATGGATGAA CGAAATAGAC AGATCGCTGA GATAGGTGCC TCACTGATTA
 4081 AGCATTTGGTA ACTGTCAGAC CAAGTTTACT CATATATACT TTAGATTGAT TTAAAACTTC
 4141 ATTTTAAATT TAAAGGATC TAGGTGAAGA TCCTTTTTGA TAATCTCATG ACCAAAATCC
 4201 CTTAACGTGA GTTTTCGTTT CACTGAGCGT CAGACCCCGT AGAAAAGATC AAAGGATCTT
 4261 CTTGAGATCC TTTTTCGTTT CGCGTAATCT GCTGCTTGCA AACAAAAAAA CCACCGCTAC
 4321 CAGCGGTGGT TTGTTTGCCG GATCAAGAGC TACCAACTCT TTTTCCGAAG GTAACTGGCT
 4381 TCAGCAGAGC GCAGATACCA AATACTGTCC TTCTAGTGTA GCCGTAGTTA GGCCACCACCT
 4441 TCAAGAACTC TGTAGCACCG CCTACATACC TCGCTCTGCT AATCCTGTTA CCAGTGGCTG
 4501 CTGCCAGTGG CGATAAGTCG TGTCTTACCG GGTGAGACTC AAGACGATAG TTACCGGATA
 4561 AGGCGCAGCG GTCGGGCTGA ACGGGGGGTT CGTGACACA GCCCAGCTTG GAGCGAACGA
 4621 CCTACACCGA ACTGAGATAC CTACAGCGTG AGCTATGAGA AAGCGCCACG CTTCCCGAAG
 4681 GGAGAAAGGC GGACAGGTAT CCGGTAAGCG GCAGGGTCGG AACAGGAGAG CGCAGGAGGG
 4741 AGCTTCCAGG GGGAAACGCC TGGTATCTTT ATAGTCTGTG CCGGTTTCGC CACCTCTGAC
 4801 TTGAGCGTCG ATTTTGTGA TGCTCGTCAG GGGGGCGGAG CCTATGGAAA AACGCCAGCA
 4861 ACGCGGCCTT TTTACGGTTT CTGGCCTTTT GCTGGCCTTT TGCTCACATG TTCTTCTCTG
 4921 CGTTATCCCC TGATTCTGTG GATAACCGTA TTACCGCCTT TGAGTGAGCT GATACCGCTC
 4981 GCCGAGCCG AACGACCGAG CGCAGCGAGT CAGTGAGCGA GGAAGCGGAA GAGCGCTGA
 5041 TGCGGTATTT TCTCCTTACG CATCTGTGCG GTATTTTACA CCGCATAAAT TCCGACACCA
 5101 TCGAATGGTG CAAAACCTTT CGCGGTATGG CATGATAGCG CCCGGAAGAG AGTCAATTCA
 5161 GGGTGGTGAA TGTGAAACCA GTAACGTTAT ACGATGTGCG AGAGTATGCC GGTGTCTCTT
 5221 ATCAGACCGT TTCCCGCGTG GTGAACCAGG CCAGCCACGT TTCTGCGAAA ACGCGGGAAA
 5281 AAGTGGAAGC GGCGATGGCG GAGCTGAATT ACATTCCCAA CCGCGTGGCA CAACAACTGG
 5341 CCGGCAACA GTCTTGCTG ATTGGCGTTG CCACCTCCAG TCTGGCCCTG CACGCGCCGT
 5401 CGCAAATTGT CGCGGCGATT AAATCTCGCG CCGATCAACT GGGTGCCAGC GTGGTGGTGT
 5461 CGATGGTAGA ACGAAGCGGC GTCGAAGCCT GTAAAGCGGC GGTGCACAAT CTTCTCGCGC
 5521 AACGCGTCAG TGGGCTGATC ATTAACATATC CGCTGGATGA CCAGGATGCC ATTGCTGTGG
 5581 AAGCTGCCTG CACTAATGTT CCGGCGTTAT TTCTTGATGT CTCTGACCAG ACACCCATCA
 5641 ACAGTATTAT TTTCTCCCAT GAAGACGGTA CGCGACTGGG CGTGGAGCAT CTGGTCCGAT
 5701 TGGGTACCA GCAAATCGCG CTGTTAGCGG GCCCATTAAG TTCTGTCTCG GCGCGTCTGC
 5761 GTCTGGCTGG CTGGCATAAA TATCTCACTC GCAATCAAAT TCAGCCGATA GCGGAACGGG
 5821 AAGGCGACTG GAGTGCCATG TCCGGTTTTC AACAAACCAT GCAAATGCTG AATGAGGGCA
 5881 TCGTTCCAC TGCGATGCTG GTTGCCAACG ATCAGATGGC GCTGGGCGCA ATGCGCGCCA
 5941 TTACCGAGTC CGGGCTGCGC GTTGGTGCGG ATATCTCGGT AGTGGGATAC GACGATACCG
 6001 AAGACAGCTC ATGTTATATC CCGCCGTTAA CCACCATCAA ACAGGATTTT CGCCTGCTGG
 6061 GGCAAACCAG CGTGGACCGC TTGCTGCAAC TCTCTCAGGG CCAGGCGGTG AAGGGCAATC
 6121 AGCTGTTGCC CGTCTCACTG GTGAAAAGAA AAACCACCCT GGCGCCCAAT ACGCAAACCG-

FIGURE 23C

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6181 CCTCTCCCCG CGCGTTGGCC GATTCATTAA TGCAGCTGGC ACGACAGGTT TCCCGACTGG
6241 AAAGCGGGCA GTGAGCGCAA CGCAATTAAT GTGAGTTAGC TCACTCATTG GGCACCCAG
6301 GCTTTACACT TTATGCTTCC GGCTCGTATG TTGTGTGGAA TTGTGAGCGG ATAACAATT
6361 CACACAGGAA ACAGCTATGA CCATGATTAC GGATTCACTG GCCGTCGTTT TACAACGTCG
6421 TGA CTGGGAA AACCTGGCG TTACCCAACT TAATCGCCTT GCAGCACATC CCCCTTTTCGC
6481 CAGCTGGCGT AATAGCGAAG AGGCCCCGAC CGATCGCCCT TCCCAACAGT TGC GCAGCCT
6541 GAATGGCGAA TGGCGCTTTG CCTGGTTTCC GGCACCAGAA GCGGTGCCGG AAAGCTGGCT
6601 GGAGTGCGAT CTTCTGAGG CCGATACTGT CGTCGTCCCC TCAAACCTGGC AGATGCACGG
6661 TTACGATGCG CCCATCTACA CCAACGTAAC CTATCCCATT ACGGTCAATC CGCCGTTTGT
6721 TCCCACGGAG AATCCGACGG GTTGTTACTC GCTCACATTT AATGTTGATG AAAGCTGGCT
6781 ACAGGAAGGC CAGACGCGAA TTATTTTTGA TGGCGTTGGA ATT

FIGURE 23D

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pDEST4 6964 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
964..1003		Trc
1577..1453		attR1
1827..2486		CmR
2606..2690		inactivated ccdA
2828..3133		ccdB
3174..3298		attR2
3872..4777		ampR
5378..5538		ori
5778..6215		flori (f1 intergenic region)
6587..704		lacIq

1	CTATCCGCTG	GATGACCAGG	ATGCCATTGC	TGTGGAAGCT	GCCTGCACTA	ATGTTCCGGC
61	GTTATTTCTT	GATGTCTCTG	ACCAGACACC	CATCAACAGT	ATTATTTTCT	CCCATGAAGA
121	CGGTACGCGA	CTGGGCGTGG	AGCATCTGGT	CGCATTGGGT	CACCAGCAAA	TCGCGCTGTT
181	AGCGGGCCCCA	TTAAGTTCTG	TCTCGGCGCG	TCTGCGTCTG	GCTGGCTGGC	ATAAATATCT
241	CACTCGCAAT	CAAATTCAGC	CGATAGCGGA	ACGGGAAGGC	GACTGGAGTG	CCATGTCCGG
301	TTTTCAACAA	ACCATGCAAA	TGCTGAATGA	GGGCATCGTT	CCCCTGCGA	TGCTGGTTGC
361	CAACGATCAG	ATGGCGCTGG	GCGCAATGCG	CGCCATTACC	GAGTCCGGGC	TGCGCGTTGG
421	TGCGGATATC	TGCGTAGTGG	GATACGACGA	TACCGAAGAC	AGCTCATGTT	ATATCCCGCC
481	GTCAACCACC	ATCAAACAGG	ATTTTCGCCT	GCTGGGGCAA	ACCAGCGTGG	ACCGCTTGCT
541	GCAACTCTCT	CAGGGCCAGG	CGGTGAAGGG	CAATCAGCTG	TTGCCCCTCT	CACTGGTGAA
601	AAGAAAAACC	ACCCTGGCAC	CCAATACGCA	AACCGCCTCT	CCCCGCGCGT	TGGCCGATTC
661	ATTAATGCAG	CTGGCACGAC	AGGTTTCCCG	ACTGGAAAGC	GGGCAGTGAG	CGCAACGCAA
721	TTAATGTGAG	TTAGCGCGAA	TTGATCTGGT	TTGACAGCTT	ATCATCGACT	GCACGGTGCA
781	CCAATGCTTC	TGGCGTCAGG	CAGCCATCGG	AAGCTGTGGT	ATGGCTGTGC	AGGTCGTAAA
841	TCACTGCATA	ATTCTGTCTG	CTCAAGGCGC	ACTCCCGTTC	TGGATAATGT	TTTTTGCGCC
901	GACATCATAA	CGGTTCTGGC	AAATATTCTG	AAATGAGCTG	TTGACAATTA	ATCATCCGGT
961	CCGTATAATC	TGTGGAATTG	TGAGCGGATA	ACAATTTTAC	ACAGGAAACA	GACCATGGGT
1021	CATCATCATC	ATCATCACGA	TTACGATATC	CCAACGACCG	AAAACCTGTA	TTTTCAGGGC
1081	GCCCATATGA	GCGATAAAAT	TATTCACCTG	ACTGACGACA	GTTTTGACAC	GGATGTACTC
1141	AAAGCGGACG	GGGCGATCCT	CGTCGATTTT	TGGGCAGAGT	GGTGCGGTCC	GTGCAAAATG
1201	ATCGCCCCGA	TTCTGGATGA	AATCGCTGAC	GAATATCAGG	GCAAACCTGAC	CGTTGCAAAA
1261	CTGAACATCG	ATCAAAACCC	TGGCACTGCG	CCGAAATATG	GCATCCGTGG	TATCCCGACT
1321	CTGCTGCTGT	TCAAAAACGG	TGAAGTGCGG	GCAACCAAAG	TGGGTGCACT	GTCTAAAGGT
1381	CAGTTGAAAG	AGTTCCTCGA	CGCTAACCTG	GCCGCTTCTG	GTTCTGGTGA	TGACGATGAC
1441	AAGGTACCCA	TCACAAGTTT	GTACAAAAAA	GCTGAACGAG	AAACGTAAAA	TGATATAAAT
1501	ATCAATATAT	TAAATTAGAT	TTTGACATAA	AAACAGACTA	CATAATACTG	TAAAACACAA
1561	CATATCCAGT	CACTATGGCG	GCCGCTAAGT	TGGCAGCATC	ACCCGACGCA	CTTGCGCCCG
1621	AATAAATACC	TGTGACGGAA	GATCACTTCG	CAGAATAAAT	AAATCCTGGT	GTCCCTGTTG
1681	ATACCGGGAA	GCCCTGGGCC	AACTTTGGC	GAAAAATGAGA	CGTTGATCGG	CACGTAAGAG
1741	GTTCCCACTT	TCACCATAAT	GAAATAAGAT	CATACCGGG	CGTATTTTTT	GAGTTATCGA
1801	GATTTTCAGG	AGCTAAGGAA	GCTAAAATGG	AGAAAAAAT	CACTGGATAT	ACCACCGTTG
1861	ATATATCCCA	ATGGCATCGT	AAAGAACATT	TTGAGGCATT	TCAGTCAGTT	GCTCAATGTA
1921	CCTATAACCA	GACCGTTCAG	CTGGATATTA	CGGCCTTTTT	AAAGACCGTA	AAGAAAAATA
1981	AGCACAAAGT	TTATCCGGCC	TTTATTCACA	TTCTTGCCCC	CCTGATGAAT	GCTCATCCGG
2041	AATTCGGTAT	GGCAATGAAA	GACGGTGAGC	TGGTGATATG	GGATAGTGTT	CACCCTTGTT
2101	ACACCGTTTT	CCATGAGCAA	ACTGAAACGT	TTTCATCGCT	CTGGAGTGAA	TACCACGACG
2161	ATTTCCGGCA	GTTTCTACAC	ATATATTCGC	AAGATGTGGC	GTGTTACGGT	GAAAACTGG
2221	CCTATTTCCC	TAAAGGGTTT	ATTGAGAATA	TGTTTTTCGT	CTCAGCCAAT	CCCTGGGTGA
2281	GTTTCACCAG	TTTTGATTTA	AACGTGGCCA	ATATGGACAA	CTTCTTCGCC	CCCGTTTTCA
2341	CCATGGGCAA	ATATTATACG	CAAGGCGACA	AGGTGCTGAT	GCCGCTGGCG	ATTCAGGTTT
2401	ATCATGCCGT	CTGTGATGGC	TTCCATGTGC	GCAGAATGCT	TAATGAATTA	CAACAGTACT
2461	GCGATGAGTG	GCAGGGCGGG	GCGTAAACGC	GTGGATCCGG	CTTACTAAAA	GCCAGATAAC
2521	AGTATGCGTA	TTTGCGCGCT	GATTTTTGCG	GTATAAGAAT	ATATACTGAT	ATGTATACCC-

FIGURE 24B

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2581 GAAGTATGTC AAAAAGAGGT GTGCTATGAA GCAGCGTATT ACAGTGACAG TTGACAGCGA
 2641 CAGCTATCAG TTGCTCAAGG CATATATGAT GTCAATATCT CCGGTCTGGT AAGCACAACC
 2701 ATGCAGAAATG AAGCCCGTGG TCTGCGTGCC GAACGCTGGA AAGCGGAAAA TCAGGAAGGG
 2761 ATGGCTGAGG TCGCCCGGTT TATTGAAATG AACGGCTCTT TTGCTGACGA GAACAGGGGAC
 2821 TGGTGAAATG CAGTTTAAGG TTTACACCTA TAAAAGAGAG AGCCGTTATC GTCTGTTTGT
 2881 GGATGTACAG AGTGATATTA TTGACACGCC CGGGCGACGG ATGGTGATCC CCCTGGCCAG
 2941 TGCACGTCTG CTGTCAGATA AAGTCTCCCG TGAACCTTAC CCGGTGGTGC ATATCGGGGA
 3001 TGAAAGCTGG CGCATGATGA CCACCGATAT GGCCAGTGTG CCGGTCTCCG TTATCGGGGA
 3061 AGAAGTGGCT GATCTCAGCC ACCCGGAAAA TGACATCAAA AACGCCATTA ACCTGATGTT
 3121 CTGGGGAATA TAAATGTCAG GCTCCCTTAT ACACAGCCAG TCTGCAGGTC GACCATAGTG
 3181 ACTGGATATG TTGTGTTTTA CAGTATTATG TAGTCTGTTT TTTATGCAAA ATCTAATTTA
 3241 ATATATTGAT ATTTATATCA TTTTACGTTT CTCGTTACAG TTTCTTGAC AAAGTGGTGA
 3301 TGGGGATCCT CTAGAGTCGA CCTGCAGTAA TCGTACAGGG TAGTACAAAT AAAAAAGGCA
 3361 CGTCAGATGA CGTGCCCTTTT TTCTTGAGAG CAGTAAGCTT GGCTGTTTTG GCGGATGAGA
 3421 GAAGATTTTC AGCCTGATAC AGATTAAATC AGAACGCAGA AGCGGTCTGA TAAACAGAA
 3481 TTTGCCTGGC GGCAGTAGCG CGGTGGTCCC ACCTGACCCC ATGCCGAAC CAGAAGTGAA
 3541 ACGCCGTAGC GCCGATGGTA GTGTGGGGTC TCCCCATGCG AGAGTAGGGA ACTGCCAGGC
 3601 ATCAAATAAA ACGAAAGGCT CAGTCGAAAG ACTGGGCTT TCGTTTTATC TGTTGTTTGT
 3661 CGGTGAACGC TCTCCTGAGT AGGACAAATC CGCCGGGAGC GGATTTGAAC GTTGCGAAGC
 3721 AACGGCCCGG AGGGTGGCGG GCAGGACGCC CGCCATAAAC TGCCAGGCAT CAAATTAAGC
 3781 AGAAGGCCAT CCTGACGGAT GGCTTTTGTG CGTTTCTACA AACTCTTTTT GTTTATTTTT
 3841 CTAAATACAT TCAAATATGT ATCCGCTCAT GAGACAATAA CCCTGATAAA TGCTTCAATA
 3901 ATATTGAAAA AGGAAGAGTA TGAGTATTCA ACATTTCCGT GTCGCCCTTA TTCCCTTTTT
 3961 TGCGGCATTT TGCTTCTCTG TTTTGTCTCA CCCAGAAACG CTGGTGAAAG TAAAAGATGC
 4021 TGAAGATCAG TTGGGTGCAC GAGTGGGTTA CATCGAACTG GATCTCAACA GCGGTAAGAT
 4081 CCTTGAGAGT TTTCCGCCCCG AAGAACGTTT TCCAATGATG AGCACTTTTA AAGTTCTGCT
 4141 ATGTGGCGCG GTATTATCCC GTGTTGACGC CGGGCAAGAG CAACTCGGTC GCCGCATACA
 4201 CTATTCTCAG AATGACTTGG TTGAGTACTC ACCAGTCACA GAAAAGCATC TTACGGATGG
 4261 CATGACAGTA AGAGAATTAT GCAGTGCTGC CATAACCATG AGTGATAACA CTGCGGCCAA
 4321 CTTACTTCTG ACAACGATCG GAGGACCGAA GGAGCTAACC GCTTTTTTGC ACAACATGGG
 4381 GGATCATGTA ACTCGCCTTG ATCGTTGGGA ACCGGAGCTG AATGAAGCCA TACCAAACGA
 4441 CGAGCGTGAC ACCACGATGC CTACAGCAAT GGCAACAACG TTGCGCAAAC TATTAAGTGG
 4501 CGAACTACTT ACTCTAGCTT CCCGGCAACA ATTAATAGAC TGGATGGAGG CGGATAAAGT
 4561 TGCAAGACCA CTCTGCGCT CGGCCCTTCC GGCTGGCTGG TTTATTGCTG ATAAATCTGG
 4621 AGCCGGTGAG CGTGGGTCTC GCGGTATCAT TGCAGCACTG GGGCCAGATG GTAAGCCCTC
 4681 CCGTATCGTA GTTATCTACA CGACGGGGAG TCAGGCAACT ATGGATGAAC GAAATAGACA
 4741 GATCGCTGAG ATAGGTGCTT CACTGATTAA GCATTGGTAA CTGTCAGACC AAGTTTACTC
 4801 ATATATACTT TAGATTGATT TAAAACCTCA TTTTAAATTT AAAAGGATCT AGGTGAAGAT
 4861 CCTTTTTGAT AATCTCATGA CCAAAATCCC TTAACGTGAG TTTTCGTTCC ACTGAGCGTC
 4921 AGACCCCGTA GAAAAGATCA AAGGATCTTC TTGAGATCCT TTTTTTCTGC CGGTAATCTG
 4981 CTGCTTGCAA ACAAAAAAAC CACCGCTACC AGCGGTGGTT TGTTTGCCGG ATCAAGAGCT
 5041 ACCAACTCTT TTTCCGAAGG TAACTGGCTT CAGCAGAGCG CAGATACCAA ATACTGTCTC
 5101 TCTAGTGTAG CCGTAGTTAG GCCACCACTT CAAGAACTCT GTAGCACCGC CTACATACCT
 5161 CGCTCTGCTA ATCCTGTTAC CAGTGGCTGC TGCCAGTGGC GATAAGTCGT GTCTTACCGG
 5221 GTTGGACTCA AGACGATAGT TACCGGATAA GGCGCAGCGG TCGGGCTGAA CGGGGGGTTC
 5281 GTGCACACAG CCCAGCTTGG AGCGAACGAC CTACACCGAA CTGAGATACC TACAGCGTGA
 5341 GCTATGAGAA AGCGCCACGC TTCCCGAAGG GAGAAAAGCG GACAGGTATC CGGTAAGCGG
 5401 CAGGGTCGGA ACAGGAGAGC GCACGAGGGA GCTTCCAGGG GGAAACGCCT GGTATCTTTA
 5461 TAGTCCTGTC GGGTTTCGCC ACCTCTGACT TGAGCGTCGA TTTTGTGAT GCTCGTCAGG
 5521 GGGGCGGAGC CTATGGAAAA ACGCCAGCAA CGCGGCCTTT TTACGGTTCC TGGCCTTTTG
 5581 CTGGCCTTTT GCTCACATGT TCTTCTCTGC GTTATCCCTT GATTCTGTGG ATAACCGTAT
 5641 TACCGCCTTT GAGTGAGCTG ATACCGCTCG CCGCAGCCGA ACGACCGAGC GCAGCGAGTC
 5701 AGTGAGCGAG GAAGCGGAAG AGCGCCTGAT GCGGTATTTT CTCCTTACGC ATCTGTGCGG
 5761 TATTTTACAC CGCATAATTT TGTTAAATTT CGCGTTAAAT TTTTGTAAA TCAGCTCATT
 5821 TTTTAACCAA TAGGCCGAAA TCGGCCAAAT CCCTTATAAA TCAAAGAAT AGACCGAGAT
 5881 AGGGTTGAGT GTTGTTCAG TTTGGAACAA GAGTCCACTA TTAAAGAACG TGGACTCCAA
 5941 CGTCAAAGGG CGAAAAACCG TCTATCAGGG CGATGGCCCA CTACGTGAAC CATCACCTTA
 6001 ATCAAGTTTT TTGGGGTCGA GGTGCCGTAA AGCACTAAAT CGGAACCTTA AAGGGAGCCC-

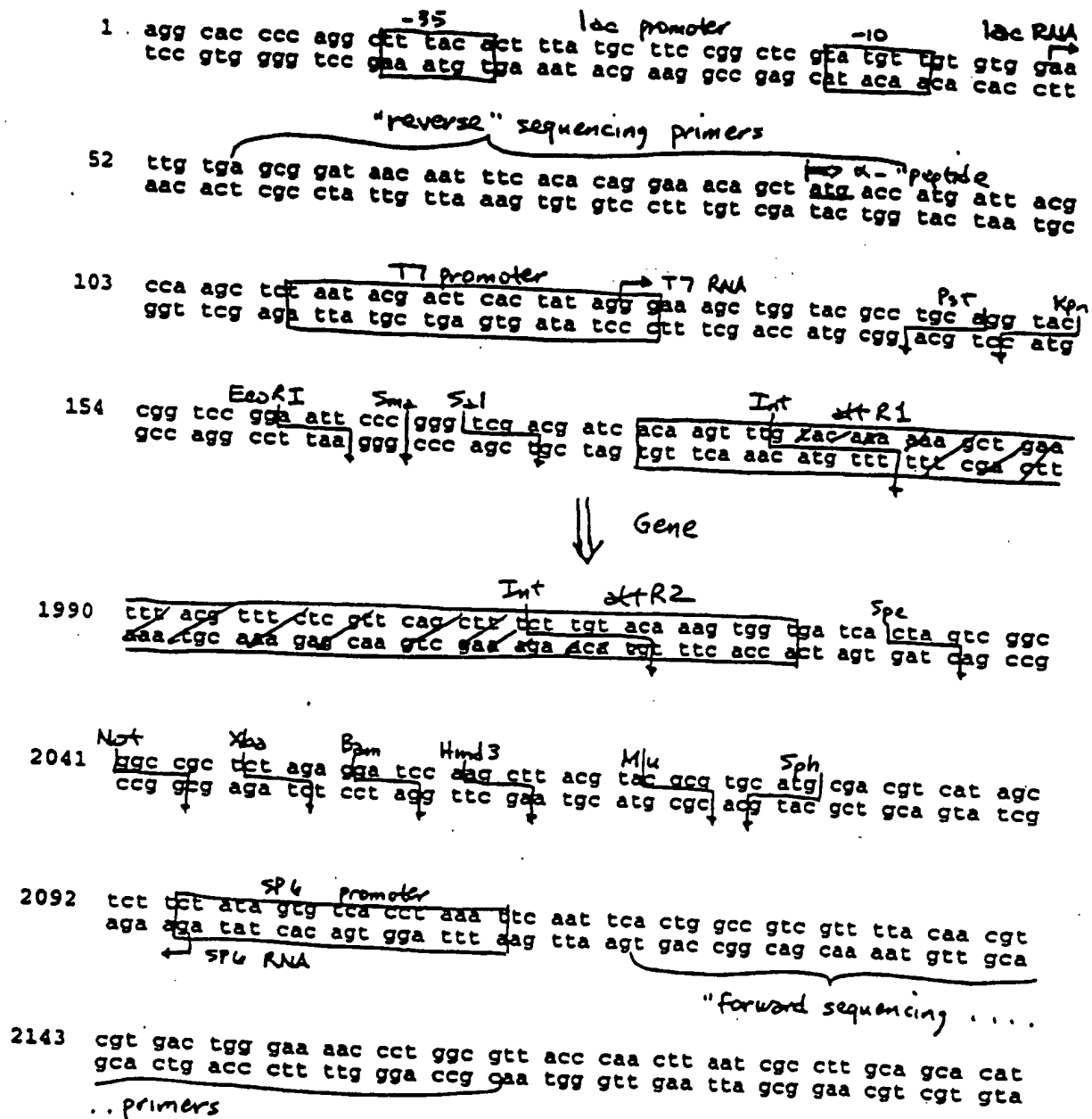
FIGURE 24C

6061 CCGATTTAGA GCTTGACGGG GAAAGCCGGC GAACGTGGCG AGAAAGGAAG GGAAGAAAGC
6121 GAAAGGAGCG GGCGCTAGGG CGCTGGCAAG TGTAGCGGTC ACGCTGCGCG TAACCACCAC
6181 ACCCGCCGCG CTTAATGCGC CGCTACAGGG CGCGTCCATT CGCCATTCAG GCTGCTATGG
6241 TGCACTCTCA GTACAATCTG CTCTGATGCC GCATAGTTAA GCCAGTATAC ACTCCGCTAT
6301 CGCTACGTGA CTGGGTCATG GCTGCGCCCC GACACCCGCC AACACCCGCT GACGCGCCCT
6361 GACGGGCTTG TCTGCTCCCG GCATCCGCTT ACAGACAAGC TGTGACCGTC TCCGGGAGCT
6421 GCATGTGTCA GAGGTTTTCA CCGTCATCAC CGAAACGCGC GAGGCAGCAG ATCAATTCGC
6481 GCGCGAAGGC GAAGCGGCAT GCATTTACGT TGACACCATC GAATGGTGCA AAACCTTTCG
6541 CGGTATGGCA TGATAGCGCC CGGAAGAGAG TCAATTCAGG GTGGTGAATG TGAAACCAGT
6601 AACGTTATAC GATGTCGCAG AGTATGCCGG TGTCTCTTAT CAGACCGTTT CCCGCGTGGT
6661 GAACCAGGCC AGCCACGTTT CTGCGAAAAC GCGGGAAAAA GTGGAAGCGG CGATGGCGGA
6721 GCTGAATTAC ATTCCCAACC GCGTGGCACA ACAACTGGCG GGCAAACAGT CGTTGCTGAT
6781 TGGCGTTGCC ACCTCCAGTC TGGCCCTGCA CGCGCCGTCG CAAATTGTCG CGGCGATTAA
6841 ATCTCGCGCC GATCAACTGG GTGCCAGCGT GGTGGTGTG ATGGTAGAAC GAAGCGGCGT
6901 CGAAGCCTGT AAAGCGGCGG TGCACAATCT TCTCGCGCAA CGCGTCAGTN GGGCTGATCA
6961 TTAA

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Figure 25A

pDEST5

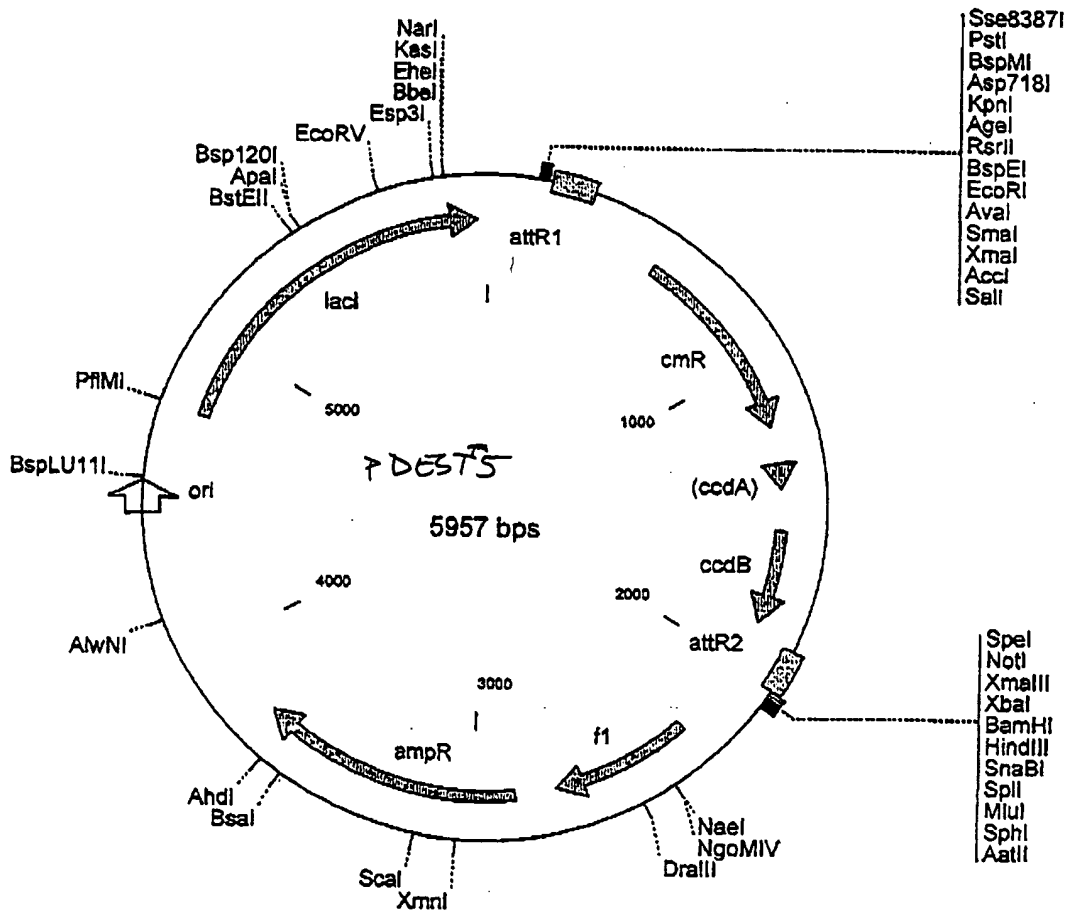
pSPORT '+' (for sequencing, probes,
phagemid)

491260

Figure 25B

7 DESTS

(cont'd)



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pDEST5 5957 bp

<u>Location (Base Nos.)</u>			<u>Gene Encoded</u>			
	305..181		attR1			
	555..1214		CmR			
	1334..1418		inactivated ccdA			
	1556..1861		ccdB			
	1902..2026		attR2			
	2278..2733		f1 (f1 intergenic region)			
	2865..3722		ampR			
	5378..5538		ori			
	4756..5922		lacI			
1	AGGCACCCCA	GGCTTTACAC	TTTATGCTTC	CGGCTCGTAT	GTTGTGTGGA	ATTGTGAGCG
61	GATAACAATT	TCACACAGGA	AACAGCTATG	ACCATGATTA	CGCCAAGCTC	TAATACGACT
121	CACTATAGGG	AAAGCTGGTA	CGCCTGCAGG	TACCGGTCCG	GAATTCCCGG	GTCGACGATC
181	ACAAGTTTGT	ACAAAAAAGC	TGAACGAGAA	ACGTAAAATG	ATATAAATAT	CAATATATTA
241	AATTAGATTT	TGCATAAAAA	ACAGACTACA	TAATACTGTA	AAACACAACA	TATCCAGTCA
301	CTATGGCGGC	CGCTAAGTTG	GCAGCATCAC	CCGACGCACT	TTGCGCCGAA	TAAATACCTG
361	TGACGGAAGA	TCACTTCGCA	GAATAAATAA	ATCCTGGTGT	CCCTGTTGAT	ACCGGGAAGC
421	CCTGGGCCAA	CTTTTGGCGA	AAATGAGACG	TTGATCGGCA	CGTAAGAGGT	TCCAACTTTC
481	ACCATAATGA	AATAAGATCA	CTACCGGGCG	TATTTTTTGA	GTTATCGAGA	TTTTCAGGAG
541	CTAAGGAAGC	TAAAATGGAG	AAAAAAATCA	CTGGATATAC	CACCGTTGAT	ATATCCCAAT
601	GGCATCGTAA	AGAACATTTT	GAGGCATTTT	AGTCAGTTGC	TCAATGTACC	TATAACCAGA
661	CCGTTTCAGCT	GGATATTACG	GCCTTTTTAA	AGACCGTAAA	GAAAAATAAG	CACAAGTTTT
721	ATCCGGCCTT	TATTCACATT	CTTGCCCCGC	TGATGAATGC	TCATCCGGAA	TTCCGTATGG
781	CAATGAAAGA	CGGTGAGCTG	GTGATATGGG	ATAGTGTTCA	CCCTTGTTAC	ACCGTTTTCC
841	ATGAGCAAAC	TGAAACGTTT	TCATCGCTCT	GGAGTGAATA	CCACGACGAT	TTCCGGCAGT
901	TTCTACACAT	ATATTGCAAA	GATGTGGCGT	GTTACGGTGA	AAACCTGGCC	TATTTCCCTA
961	AAGGGTTTAT	TGAGAATATG	TTTTTCGTCT	CAGCCAATCC	CTGGGTGAGT	TTCACCAGTT
1021	TTGATTTAAA	CGTGGCCAAT	ATGGACAAC	TCTTCGCCCC	CGTTTTTACC	ATGGGCAAAT
1081	ATTATACGCA	AGGCGACAAG	GTGCTGATGC	CGCTGGCGAT	TCAGGTTTAT	CATGCCGTCT
1141	GTGATGGCTT	CCATGTCCGC	AGAATGCTTA	ATGAATTACA	ACAGTACTGC	GATGAGTGGC
1201	AGGGCGGGGC	GTAAACGCGT	GGATCCGGCT	TACTAAAAGC	CAGATAACAG	TATGCGTATT
1261	TGCGCGCTGA	TTTTTGCGGT	ATAAGAATAT	ATACTGATAT	GTATACCCGA	AGTATGTCAA
1321	AAAGAGGTGT	GCTATGAAGC	AGCGTATTAC	AGTGACAGTT	GACAGCGACA	GCTATCAGTT
1381	GCTCAAGGCA	TATATGATGT	CAATATCTCC	GGTCTGGTAA	GCACAACCAT	GCAGAATGAA
1441	GCCCCGTCGT	TGCGTGCCGA	ACGCTGGAAA	GCGGAAAATC	AGGAAGGGAT	GGCTGAGGTC
1501	GCCCCGTTTA	TTGAAATGAA	CGGCTCTTTT	GCTGACGAGA	ACAGGGACTG	GTGAAATGCA
1561	GTTTAAGGTT	TACACCTATA	AAAGAGAGAG	CCGTTATCGT	CTGTTTGTGG	ATGTACAGAG
1621	TGATATTATT	GACACGCCCG	GGCGACGGAT	GGTGATCCCC	CTGGCCAGTG	CACGCTCTGCT
1681	GTCAGATAAA	GTCTCCCGTG	AACTTTACCC	GGTGGTGCAT	ATCGGGGATG	AAAGCTGGCG
1741	CATGATGACC	ACCGATATGG	CCAGTGTGCC	GGTCTCCGTT	ATCGGGGAAG	AAGTGGCTGA
1801	TCTCAGCCAC	CGCGAAAATG	ACATCAAAAA	CGCCATTAA	CTGATGTTCT	GGGGAATATA
1861	AATGTCAGGC	TCCCTTATAC	ACAGCCAGTC	TGCAGGTCGA	CCATAGTGAC	TGGATATGTT
1921	GTGTTTTACA	GTATTATGTA	GTCTGTTTTT	TATGCAAAAT	CTAATTTAAT	ATATTGATAT
1981	TTATATCATT	TTACGTTTCT	CGTTCAGCTT	TCTTGATCAA	AGTGGTGATC	ACTAGTCGGC
2041	GGCCGCTCTA	GAGGATCCAA	GCTTACGTAC	GCGTGCATGC	GACGTCATAG	CTCTTCTATA
2101	GTGTCACCTA	AATTCAATTC	ACTGGCCGTC	GTTTTACAAC	GTCGTGACTG	GGAAAACCCCT
2161	GGCGTTACCC	AACTTAATCG	CCTTGCAGCA	CATCCCCCTT	TCGCCAGCTG	GCGTAATAGC
2221	GAAGAGGCCC	GCACCGATCG	CCCTTCCCAA	CAGTTGCGCA	GCCTGAATGG	CGAATGGACG
2281	CGCCCTGTAG	CGGCGCATTA	AGCGCGGCGG	GTGTGGTGGT	TACGCGCAGC	GTGACCGCTA
2341	CACTTGCCAG	CGCCCTAGCG	CCCGCTCCTT	TCGCTTTCTT	CCCTTCCTTT	CTCGCCACGT
2401	TCGCCGGCTT	TCCCCGTCAA	GCTCTAAATC	GGGGGCTCCC	TTTAGGGTTC	CGATTTAGTG
2461	CTTTACGGCA	CCTCGACCCC	AAAAAACTTG	ATTAGGGTGA	TGGTTACAGT	AGTGGGCCAT
2521	CGCCCTGATA	GACGGTTTTT	CGCCCTTTGA	CGTTGGAGTC	CACGTTCTTT	AATAGTGGAC
2581	TCTTGTTCCA	AACTGGAACA	ACACTCAACC	CTATCTCGGT	CTATTCTTTT	GATTTATAAG-

FIGURE 25C

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2641 GGATTTTGGC GATTTTCGGC TATTGGTTAA AAAATGAGCT GATTTAACAA AAATTTAACG
2701 CGAATTTTAA CAAAATATTA ACGTTTACAA TTTCAGGTGG CACTTTTCGG GGAAATGTGC
2761 GCGGAACCCC TATTTGTTTA TTTTCTAA TACATTCAA TATGTATCCG CTCATGAGAC
2821 AATAACCCTG ATAAATGCTT CAATAATATT GAAAAAGGAA GAGTATGAGT ATTCAACATT
2881 TCCGTGTGCG CCTTATTCCC TTTTTCGGG CATTTTGCCT TCCTGTTTTT GCTCACCAG
2941 AAACGCTGGT GAAAGTAAAA GATGCTGAAG ATCAGTTGGG TGCACGAGTG GGTACATCG
3001 AACTGGATCT CAACAGCGGT AAGATCCTTG AGAGTTTTCG CCCCGAAGAA CGTTTTCCAA
3061 TGATGAGCAC TTTTAAAGTT CTGCTATGTG GCGCGGTATT ATCCCGTATT GACGCCGGGC
3121 AAGAGCAACT CGGTCGCCGC ATACACTATT CTCAGAATGA CTTGGTTGAG TACTACCAG
3181 TCACAGAAAA GCATCTTACG GATGGCATGA CAGTAAGAGA ATTATGCAGT GCTGCCATAA
3241 CCATGAGTGA TAACACTGCG GCCAACTTAC TTCTGACAAC GATCGGAGGA CCGAAGGAGC
3301 TAACCGCTTT TTTGCACAAC ATGGGGGATC ATGTAACCTG CTTGATCGT TGGGAACCGG
3361 AGCTGAATGA AGCCATACCA AACGACGAGC GTGACACCAC GATGCCTGTA GCAATGGCAA
3421 CAACGTTGCG CAAACTATTA ACTGGCGAAC TACTTACTCT AGCTTCCCGG CAACAATTAA
3481 TAGACTGGAT GGAGGCGGAT AAAGTTGCAG GACCACTTCT GCGCTCGGCC CTTCCGGCTG
3541 GCTGGTTTAT TGCTGATAAA TCTGGAGCCG GTGAGCGTGG GTCTCGCGGT ATCATTGCAG
3601 CACTGGGGCC AGATGGTAAG CCCTCCCGTA TCGTAGTTAT CTACACGACG GGGAGTCAGG
3661 CAACTATGGA TGAACGAAAT AGACAGATCG CTGAGATAGG TGCCTCACTG ATTAAGCATT
3721 GGTAACGTG AGACCAAGTT TACTCATATA TACTTTAGAT TGATTTAAAA CTTCAATTTT
3781 AATTTAAAAG GATCTAGGTG AAGATCCTTT TTGATAATCT CATGACCAAA ATCCCTTAAC
3841 GTGAGTTTTC GTTCCACTGA GCGTCAGACC CCGTAGAAAA GATCAAAGGA TCTTCTTGAG
3901 ATCCTTTTTT TCTGCGCGTA ATCTGCTGCT TGCAAACAAA AAAACCACCG CTACCAGCGG
3961 TGGTTTGTGT GCCGGATCAA GAGCTACCAA CTCTTTTTCC GAAGGTAAC TGGCTCAGCA
4021 GAGCGCAGAT ACCAAATACT GTCCTTCTAG TGTAGCCGTA GTTAGGCCAC CACTTCAAGA
4081 ACTCTGTAGC ACCGCCTACA TACCTCGCTC TGCTAATCCT GTTACCAGTG GCTGCTGCCA
4141 GTGGCGATAA GTCGTGTCTT ACCGGGTTGG ACTCAAGACG ATAGTTACCG GATAAGGCGC
4201 AGCGGTCGGG CTGAACGGGG GGTTCGTGCA CACAGCCCAG CTTGGAGCGA ACGACCTACA
4261 CCGAACTGAG ATACCTACAG CGTGAGCATT GAGAAAGCGC CACGCTTCCC GAAGGGAGAA
4321 AGGCGGACAG GTATCCGTA AGCGGCAGGG TCGGAACAGG AGAGCGCACG AGGGAGCTTC
4381 CAGGGGAAAA CGCCTGGTAT CTTTATAGTC CTGTGCGGTT TCGCCACCTC TGACTTGAGC
4441 GTCGATTTTT GTGATGCTCG TCAGGGGGGC GGAGCCTATG GAAAAACGCC AGCAACGCGG
4501 CTTTTTTACG GTTCTTGCC TTTTGCTGGC CTTTTGCTCA CATGTTCTTT CCTGCGTTAT
4561 CCCCTGATTC TGTGGATAAC CGTATTACCG CTTTGAGTG AGCTGATACC GCTCGCCGCA
4621 GCCGAACGAC CGAGCGCAGC GAGTCAGTGA GCGAGGAAGC GGAAGAGCGC CCAATACGCA
4681 AACCGCCTCT CCCCAGCGCT TGGCCGATTC ATTAATGCAG AGCTTGCAAT TCGCGCGCGA
4741 AGGCGAAGCG GCATTTACGT TGACACCATC GAATGGCGCA AAACCTTTCC CGGTATGGCA
4801 TGATAGCGCC CGGAAGAGAG TCAATTCAGG GTGGTGAATG TGAAACAGT AACGTTATAC
4861 GATGTGCGAG AGTATGCCGG TGTCTTTAT CAGACCGTTT CCCGCGTGGT GAACCAGGCC
4921 AGCCACGTTT CTGCGAAAAA GCGGGAAAAA GTGGAAGCGG CGATGGCGGA GCTGAATTAC
4981 ATTCCCAACC GCGTGGCACA ACAACTGGCG GGCAAACAGT CGTTGCTGAT TGGCGTTGCC
5041 ACCTCCAGTC TGGCCCTGCA CGCGCCGTCG CAAATTGTCG CGGCGATTAA ATCTCGCGCC
5101 GATCAACTGG GTGCCAGCGT GGTGGTGTG ATGGTAGAAC GAAGCGGCGT CGAAGCCTGT
5161 AAAGCGGCGG TGCACAATCT TCTCGCGCAA CGGGTCACTG GGCTGATCAT TAACATCCG
5221 CTGGATGACC AGGATGCCAT TGCTGTGGAA GCTGCCTGCA CTAATGTTCC GCGGTTATTT
5281 CTTGATGTCT CTGACCAGAC ACCCATCAAC AGTATTATTT TCTCCCATGA AGACGGTACG
5341 CGACTGGGCG TGGAGCATCT GGTCCGATTG GGTCAACAGC AAATCGCGCT GTTAGCGGGC
5401 CCATTAAGTT CTGTCTCGGC GCGTCTGCGT CTGGCTGGCT GGCATAAATA TCTCACTCGC
5461 AATCAAATTC AGCCGATAGC GGAACGGGAA GGCGACTGGA GTGCCATGTC CGGTTTTCAA
5521 CAAACCATGC AAATGCTGAA TGAGGGCATC GTTCCCACTG CGATGCTGGT TGCCAACGAT
5581 CAGATGGCGC TGGGCGCAAT GCGCGCCATT ACCGAGTCCG GGCTGCGCGT TGGTGGCGAT
5641 ATCTCGGTAG TGGGATACGA CGATACCGAA GACAGCTCAT GTTATATCCC GCCGTCAACC
5701 ACCATCAAAC AGGATTTTCG CCTGCTGGGG CAAACCAGCG TGGACCGCTT GCTGCAACTC
5761 TCTCAGGGCC AGGCGGTGAA GGGCAATCAG CTGTTGCCCG TCTCACTGGT GAAAAGAAAA
5821 ACCACCTGG CGCCCAATAC GCAAACCGCC TCTCCCCGCG CGTTGGCCGA TTCATTAATG
5881 CAGCTGGCAC GACAGGTTTC CCGACTGGAA AGCGGGCAGT GAGCGCAACG CAATTAATGT
5941 GAGTTAGCTC ACTCATT

FIGURE 25D

Figure 26A

pDEST6

pSPORT "4"
(opposite strand)

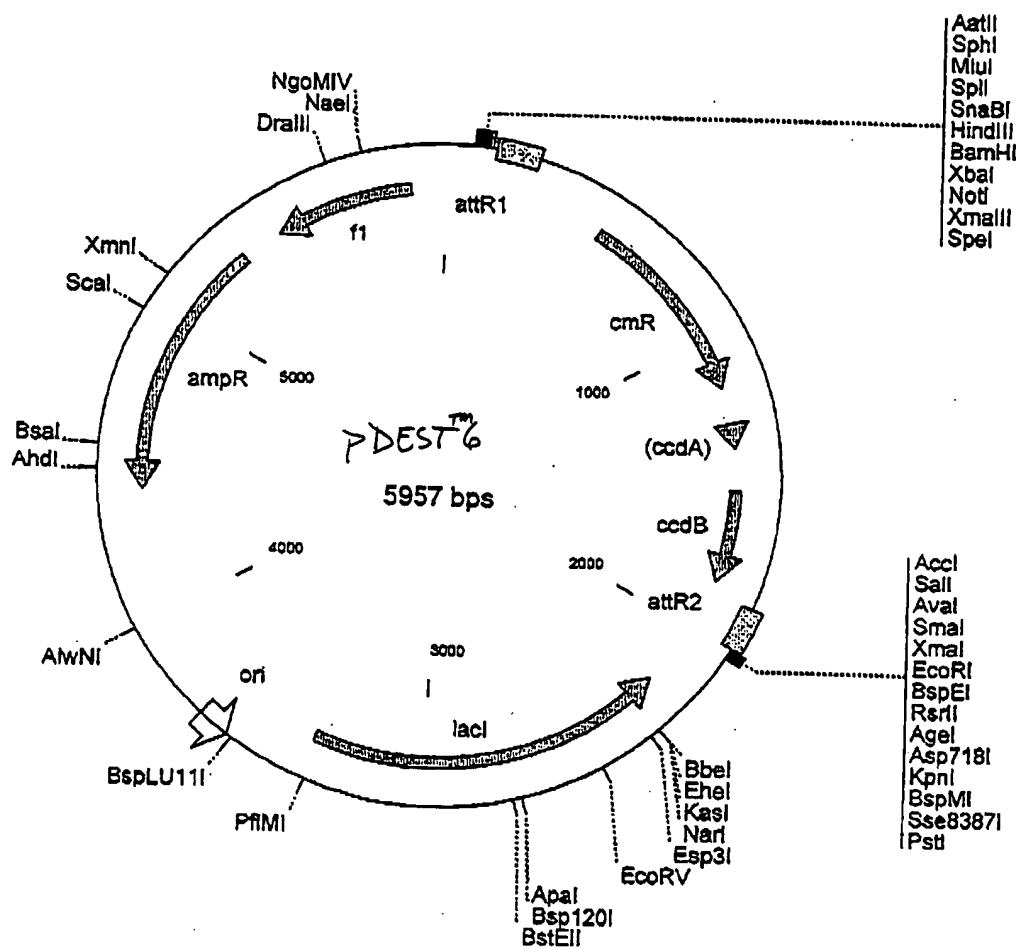
"forward" sequencing primers

- 1 taa cgc cag ggt ttt ccc agt cac gac gtt gta aaa cga cgg cca gtg aat
att gcg gtc cca aaa ggg tca gtg ctg caa cat ttt gct gcc ggt cac tta
- 52 tga att tag gtg aca cta tag aag agc tat gac gtc gca tgc acg cgt acg
act taa atc cac tgt gat atc ttc tgc ata ctg cag cgt acg tgc gca tgc
- 103 taa gct tgg atc ctc tag agc ggc cgc cga cta gtg atc aca agt tgg cag
att cga acc tag gag atc tgc cgc ggc gct gat cag tag tgt tca aac atg
- 154 aca aac gct gaa cga gaa acg taa aat gat ata aat atc aag ata tca aat
ttt tct cga ttt gct ctt tgc att tta cta tat tca tag tta tat aat tca
- ↓ Gene
- 1939 tat tta tat tat ttt acg ttt ctc gtt tag ctt tct tgt aca aag tgg tga
ata aat ata gta aaa tgc aac gag gaa gtc gaa aga aca tgt ttc acc att
- 1990 tgc tgc acc cgg gaa ttc cgg acc ggt act tgc agg cgt acc agc ttt ccc
agc agc tgg gcc ctt aag gcc tgg gca tgg acg tcc gca tgg tgc aaa ggg
- T7 RNA
- 2041 tat agt gag tgc tat tag agc ttg gcg taa tca tgg tca tag ctg ttt cct
ata tca ctc agc ata atc tgc aac cgc att agt acc agt atc gac aaa gga
- T7 promoter α-peptide
- "reverse .."
- 2092 gtg tga aat tgt tat cgc ctc aca att cca cac aac ata cga gct gga agc
cac act tta aca ata ggc gag tgt taa ggt gtg ttg tat gct cgg cct tgc
- ... sequencing primers lac RNA
- 2143 ata aag tgt aaa gcc tgg ggt gcc taa tga gtg agc taa ctc aca tta att
tat ttc aca ttt cgg acc cca cgg att act cac tgc att gag tgt aat taa

S3/240

Figure 26B

PDEST6 (cont'd)



54/240

pDEST6 5957 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
266..142		attR1
516..1175		CmR
1295..1379		inactivated ccdA
1517..1822		ccdB
1863..1987		attR2
2203..3369		lacI
4403..5260		ampR
5392..5847		f1 (f1 intergenic region)
1	TAACGCCAGG GTTTTCCCAG TCACGACGTT GTAAAACGAC GGCCAGTGAA TTGAATTTAG	
61	GTGACACTAT AGAAGAGCTA TGACGTCGCA TGCACGCGTA CGTAAGCTTG GATCCTCTAG	
121	AGCGGCCGCC GACTAGTGAT CACAAGTTTG TACAAAAAAG CTGAACGAGA AACGTAAAAT	
181	GATATAAATA TCAATATATT AAATTAGATT TTGCATAAAA AACAGACTAC ATAATACTGT	
241	AAAACACAAC ATATCCAGTC ACTATGGCGG CCGCTAAGTT GGCAGCATCA CCCGACGCAC	
301	TTTGCGCCGA ATAAATACCT GTGACGGAAG ATCACTTCGC AGAATAAATA AATCCTGGTG	
361	TCCCTGTTGA TACCGGGAAG CCCTGGGCCA ACTTTTGGCG AAAATGAGAC GTTGATCGGC	
421	ACGTAAGAGG TTCCAACCTT CACCATAATG AAATAAGATC ACTACCGGGC GTATTTTTTG	
481	AGTTATCGAG ATTTTCAGGA GCTAAGGAAG CTAATATGGA GAAAAAATC ACTGGATATA	
541	CCACCGTTGA TATATCCCAA TGGCATCGTA AAGAACATTT TGAGGCATTT CAGTCAGTTG	
601	CTCAATGTAC CTATAACCAG ACCGTTTCAGC TGGATATTAC GGCCTTTTTA AAGACCGTAA	
661	AGAAAAATAA GCACAAGTTT TATCCGGCCT TTATTACAT TCTTGCCCGC CTGATGAATG	
721	CTCATCCGGA ATTCCGTATG GCAATGAAAG ACGGTGAGCT GGTGATATGG GATAGTGTTT	
781	ACCCTTGTTA CACCGTTTTT CATGAGCAAA CTGAAACGTT TTCATCGCTC TGGAGTGAAT	
841	ACCACGACGA TTTCCGGCAG TTTCTACACA TATATTCGCA AGATGTGGCG TGTACGGTG	
901	AAAACCTGGC CTATTTCCCT AAAGGGTTTA TTGAGAAATAT GTTTTTTCGTC TCAGCCAATC	
961	CCTGGGTGAG TTTACCAGT TTTGATTTAA ACGTGGCCAA TATGGACAAC TTCTTCGCCC	
1021	CCGTTTTTAC CATGGGCAAA TATTATACGC AAGGCGACAA GGTGCTGATG CCGCTGGCGA	
1081	TTCAGGTTCA TCATGCCGTC TGTGATGGCT TCCATGTCCG CAGATGCTT AATGAATTAC	
1141	AACAGTACTG CGATGAGTGG CAGGGCGGGG CGTAAACCGC TGGATCCGGC TTACTAAAAG	
1201	CCAGATAACA GTATGCGTAT TTGCGCGCTG ATTTTTCGGG TATAAGAATA TATACTGATA	
1261	TGTATACCCG AAGTATGTCA AAAAGAGGTG TGCTATGAAG CAGCGTATTA CAGTGACAGT	
1321	TGACAGCGAC AGCTATCAGT TGCTCAAGCG ATATATGATG TCAATATCTC CGGTCTGGTA	
1381	AGCACAAACCA TGCAGAATGA AGCCCGTCCG CTGCGTGCCG AACGCTGGAA AGCGGAAAAT	
1441	CAGGAAGGGA TGGCTGAGGT CGCCCGGTTT ATTGAAATGA ACGGCTCTTT TGCTGACGAG	
1501	AACAGGGACT GGTGAAATGC AGTTTAAGGT TTACACCTAT AAAAGAGAGA GCCGTTATCG	
1561	TCTGTTTGTG GATGTACAGA GTGATATTAT TGACACGCCC GGGCGACGGA TGGTGATCCC	
1621	CCTGGCCAGT GCACGTCTGC TGTGAGATAA AGTCTCCCGT GAACTTTACC CGGTGGTGCA	
1681	TATCGGGGAT GAAAGCTGGC GCATGATGAC CACCGATATG GCCAGTGTGC CGGTCTCCGT	
1741	TATCGGGGAA GAAGTGGCTG ATCTCAGCCA CCGCGAAAAT GACATCAAAA ACGCCATTAA	
1801	CCTGATGTTT TGGGGAATAT AAATGTCAGG CTCCTTTATA CACAGCCAGT CTGCAGGTGC	
1861	ACCATAGTGA CTGGATATGT TGTGTTTTAC AGTATTATGT AGTCTGTTTT TTATGCAAAA	
1921	TCTAATTTAA TATATTGATA TTTATATCAT TTTACGTTT TCGTTTCAGT TTCTTGATCA	
1981	AAGTGGTGAT CGTCGACCCG GGAATTCGCG ACCGGTACCT GCAGGCGTAC CAGCTTTCCC	
2041	TATAGTGAGT CGTATTAGAG CTTGGCGTAA TCATGGTCAT AGCTGTTTCC TGTGTGAAAT	
2101	TGTTATCCGC TCACAATTCC ACACAACATA CGAGCCGGAA GCATAAAGTG TAAAGCCTGG	
2161	GGTGCCTAAT GAGTGAGCTA ACTCACATTA ATTGCGTTGC GCTCACTGCC CGCTTTCCAG	
2221	TCGGGAAACC TGTGCGTCCA GCTGCATTAA TGAATCGGCC AACGCGCGGG GAGAGGCGGT	
2281	TGCGTATTG GCGCCAGGG TGGTTTTTCT TTTACCAGT GAGACGGGCA ACAGCTGATT	
2341	GCCCTTCACC GCCTGGCCCT GAGAGAGTTG CAGCAAGCGG TCCACGCTGG TTTGCCCCAG	
2401	CAGGCGAAAA TCCTGTTTGA TGGTGGTTGA CGGCGGGATA TAACATGAGC TGTCTTCGGT	
2461	ATCGTCGTAT CCCACTACCG AGATATCCGC ACCAACGCGC AGCCCGGACT CGGTAATGGC	
2521	GCGCATTGCG CCCAGCGCCA TCTGATCGTT GGCAACCAGC ATCGCAGTGG GAACGATGCC	
2581	CTCATTCAGC ATTTGCATGG TTTGTTGAAA ACCGGACATG GCACTCCAGT CGCCTTCCCC	
2641	TTCCGCTATC GGCTGAATTT GATTGCGAGT GAGATATTTA TGCCAGCCAG CCAGACGCAG-	

FIGURE 26C

2701 ACGCGCCGAG ACAGAACTTA ATGGGCCCCG TAACAGCGCG ATTTGCTGGT GACCCAATGC
2761 GACCAGATGC TCCACGCCCA GTCGCGTACC GTCTTCATGG GAGAAAATAA TACTGTTGAT
2821 GGGTGCTGG TCAGAGACAT CAAGAAATAA CGCCGGAACA TTAGTGCAGG CAGCTTCCAC
2881 AGCAATGGCA TCCTGGTCAT CCAGCGGATA GTTAATGATC AGCCCACTGA CCCGTTGCGC
2941 GAGAAGATTG TGCACCGCCG CTTTACAGGC TTCGACGCCG CTTGCTTCTA CCATCGACAC
3001 CACCACGCTG GCACCCAGTT GATCGGCGCG AGATTTAATC GCCGCGACAA TTTGCGACGG
3061 CGCGTGACAG GCCAGACTGG AGGTGGCAAC GCCAATCAGC AACGACTGTT TGCCCGCCAG
3121 TTGTTGTGCC ACGCGGTTGG GAATGTAATT CAGCTCCGCC ATCGCCGCTT CCACTTTTTC
3181 CCGCGTTTTT GCAGAAACGT GGCTGGCCTG GTTCACCACG CGGGAAACGG TCTGATAAGA
3241 GACACCGGCA TACTCTGCGA CATCGTATAA CGTTACTGGT TTCACATTCA CCACCCTGAA
3301 TTGACTCTCT TCCGGGCGCT ATCATGCCAT ACCGCGAAAG GTTTTGCGCC ATTCGATGGT
3361 GTCAACGTAA ATGCCGCTTC GCCTTCGCGC GCGAATTGCA AGCTCTGCAT TAATGAATCG
3421 GCCAACGCGC GGGGAGAGGC GGTTCGCGTA TTGGGCGCTC TTCCGCTTCC TCGCTCACTG
3481 ACTCGCTGCG CTCGCTCGTT CGGCTGCGGC GAGCGGTATC AGCTCACTCA AAGGCGGTAA
3541 TACGGTTATC CACAGAATCA GGGGATAACG CAGGAAAGAA CATGTGAGCA AAAGGCCCAGC
3601 AAAAGGCCAG GAACCGTAAA AAGGCCGCGT TGCTGGCGTT TTTCCATAGG CTCCGCCCCCC
3661 CTGACGAGCA TCACAAAAAT CGACGCTCAA GTCAGAGGTG GCGAAACCCG ACAGGACTAT
3721 AAAGATACCA GCGGTTTTCC CCTGGAAGCT CCCTCGTGCG CTCTCTGTG CCGACCCTGC
3781 CGCTTACCGG ATACCTGTCC GCCTTTCTCC CTTGCGGAAG CGTGGCGCTT TCTCAATGCT
3841 CACGCTGTAG GTATCTCAGT TCGGTGTAGG TCGTTCGCTC CAAGCTGGGC TGTGTGCACG
3901 AACCCCCCGT TCAGCCCGAC CGCTGCGCCT TATCCGGTAA CTATCGTCTT GAGTCCAACC
3961 CGGTAAGACA CGACTTATCG CCACTGGCAG CAGCCACTGG TAACAGGATT AGCAGAGCGA
4021 GGTATGTAGG CGGTGCTACA GAGTCTTGA AGTGGTGGCC TAACTACGGC TACACTAGAA
4081 GGACAGTATT TGGTATCTGC GCTCTGCTGA AGCCAGTTAC CTTGCGAAAA AGAGTTGGTA
4141 GCTCTTGATC CGGCAACAA ACCACCGCTG GTAGCGGTGG TTTTTTTGTT TGCAAGCAGC
4201 AGATTACGCG CAGAAAAAAA GGATCTCAAG AAGATCCTTT GATCTTTTCT ACGGGGTCTG
4261 ACGCTCAGTG GAACGAAAAA TCACGTAAAG GGATTTTGGT CATGAGATTA TCAAAAAGGA
4321 TCTTCACCTA GATCCTTTTA AATTAAAAAT GAAGTTTTAA ATCAATCTAA AGTATATATG
4381 AGTAAACTTG GTCTGACAGT TACCAATGCT TAATCAGTGA GGCACCTATC TCAGCGATCT
4441 GTCTATTTCG TTCATCCATA GTTGCCGTGAC TCCCCGTCGT GTAGATAACT ACGATACGGG
4501 AGGGCTTACC ATCTGGCCCC AGTGCTGCAA TGATACCGCG AGACCCACGC TCACCGGCTC
4561 CAGATTTATC AGCAATAAAC CAGCCAGCCG GAAGGGCCGA GCGCAGAAGT GGTCTTGCAA
4621 CTTTATCCGC CTCCATCCAG TCTATTAATT GTTGCCGGGA AGCTAGAGTA AGTATCTCGC
4681 CAGTTAATAG TTTGCGCAAC GTTGTGCGCA TTGCTACAGG CATCGTGGTG TCACGCTCGT
4741 CGTTTGGTAT GGCTTCATTC AGCTCCGGTT CCCAACGATC AAGGCGAGTT ACATGATCCC
4801 CCATGTTGTG CAAAAAAGCG GTTAGCTCCT TCGGTCTCCT GATCGTTGTC AGAAGTAAGT
4861 TGGCCGAGT GTTATCACTC ATGGTTATGG CAGCACTGCA TAATTCTCTT ACTGTCATGC
4921 CATCCGTAAG ATGCTTTTCT GTGACTGGTG AGTACTCAAC CAAGTCATTC TGAGAATAGT
4981 GTATGCGGCG ACCGAGTTGC TCTTGCCCGG CGTCAATACG GGATAATACC GCGCCACATA
5041 GCAGAACTTT AAAAGTGCTC ATCATTGGAA AACGTTCTTC GGGGCGAAAA CTCTCAAGGA
5101 TCTTACCGCT GTTGAGATCC AGTTCGATGT AACCCTACTG TGCACCCAAC TGATCTTCAG
5161 CATCTTTTAC TTTTACCAGC GTTCTGGGT GAGCAAAAAA AGGAAGGCAA AATGCCGCAA
5221 AAAAGGGAAT AAGGGCGACA CGGAAATGTT GAATACTCAT ACTCTTCCTT TTTCAATATT
5281 ATTGAAGCAT TTATCAGGGT TATTGTCTCA TGAGCGGATA CATATTTGAA TGTATTTAGA
5341 AAAATAAACA AATAGGGGTT CCGCGCACAT TTCCCGAAA AGTGCCACCT GAAATTGTAA
5401 ACGTTAATAT TTTGTTAAAA TTCGCGTTAA ATTTTGTGTA AATCAGCTCA TTTTTTAACC
5461 AATAGGCCGA AATCGGCAAA ATCCCTTATA AATCAAAAGA ATAGACCGAG ATAGGGTTGA
5521 GTGTTGTTCC AGTTTGGAAC AAGAGTCCAC TATTAAAGAA CGTGGACTCC AACGTCAAAG
5581 GGCAGAAAAA CGTCTATCAG GCGATGGCC CACTACGTGA ACCATCACC TAATCAAGTT
5641 TTTTGGGGTC GAGGTGCCGT AAAGCACTAA ATCGGAACCC TAAAGGGAGC CCCCAGTTA
5701 GAGCTTGACG GGGAAAGCCG GCGAACGTGG CGAGAAAGGA AGGGAAGAAA GCGAAAGGAG
5761 CGGGCGCTAG GCGGCTGGCA AGTGTAGCGG TCACGCTGCG CGTAACCACC ACACCCGCCG
5821 CGCTTAATGC GCCGCTACAG GCGCGCTCCA TTCGCCATTG AGGCTGCGCA ACTGTTGGGA
5881 AGGGCGATCG GTGCGGCCCT CTTGCTATT ACGCCAGCTG GCGAAAGGGG GATGTGCTGC
5941 AAGGCGATTA AGTTGGG

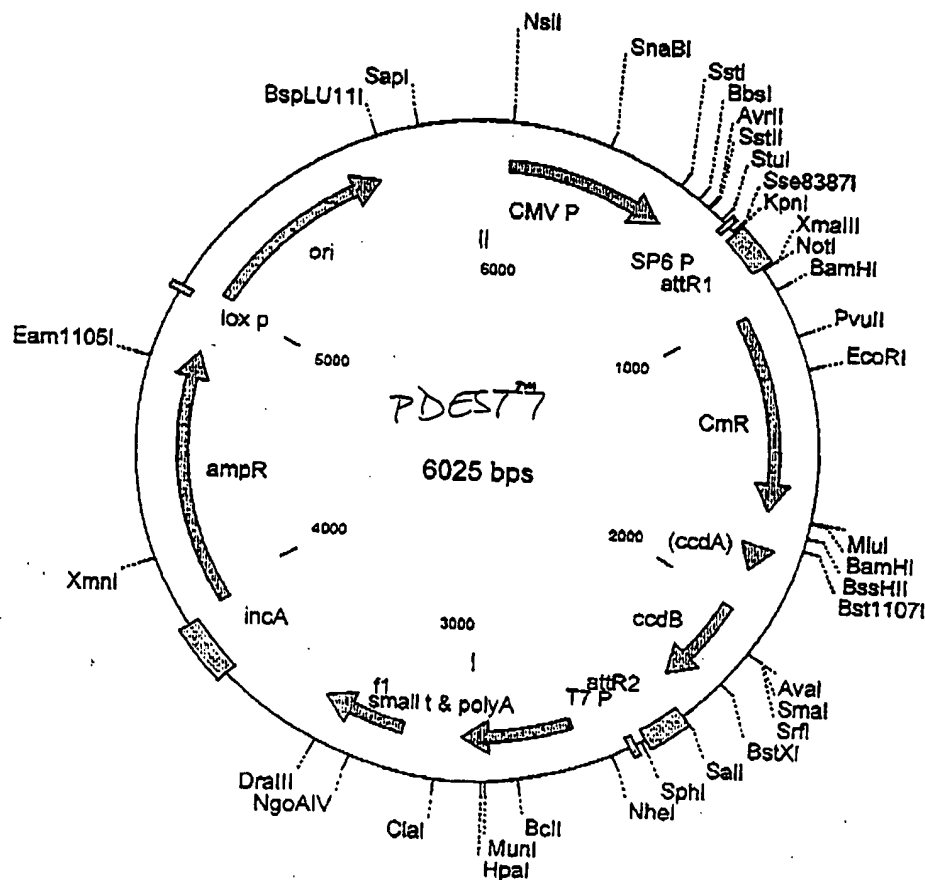
FIGURE 26D

Figure 27A: PDEST7

CMV promoter for eukaryotic expression

970 cca ttg acg caa atg ggc ggt agg cgt gta cgg tgg gag gtc tat ata agc
 ggt aac tgc gtt tac ccg cca tcc gca cat gcc acc ctc cag ata tat tcg
 1021 aga gct cgt tta gtg aac cgt cag atc gcc tgg aga cgc cat cca cgc tgt
 tct cga gca aat cac ttg gca gtc tag cgg acc tct gcg gta ggt gcg aca
 1072 ttt gac ctc cat aga aga cac cgg gac cga tcc agc ctc cgg act cta gcc
 aaa ctg gag gta tct tct gtg gcc ctg gct agg tcc gag ggc tga gat cgg
 1123 tag gcc gcg gag cgg ata aca att tca cac agg aaa cag cta tga cca cta
 atc cgg cgc ctc gcc tat tgt taa agt gtg tcc ttt gtc gat act ggt gat
 1174 ggc ttt tgc aaa aag cta ttt agg tga cac tat aga agg tac gcc tgc agg
 ccg aaa acg ttt ttc gat aaa tcc act gtg ata tct tcc atg cgg acg tct
 1225 tac cgg tcc gga att ccc atc aca agt tgg cag aag ggt gaa cga gaa
 atg gcc agg cct taa ggg tag tgt tca aac atg ttt tct cga ctc gct ctc

Handwritten annotations:
 - "mRNA start" with an arrow pointing to the ATG at position 975.
 - "CMV enhancer / promoter" with an arrow pointing to the region between positions 1021 and 1072.
 - "EcoRI" with an arrow pointing to the GAATTC site at position 1174.
 - "KpnI" with an arrow pointing to the GTACAC site at position 1225.
 - "attR1" with an arrow pointing to the attR1 site at position 1225.



pDEST7 6025 bp (rotated to position 2800)

<u>Location (Base Nos.)</u>				<u>Gene Encoded</u>		
67..589				CMV promoter		
906..782				attR1		
1015..1674				CmR		
1794..1878				inactivated ccdA		
2016..2321				ccdB		
2362..2486				attR2		
2671..3033				small t & polyA		
3227..3502				f1		
3962..4822				ampR		
5022..5661				ori		
1	ATTATCATGA	CATTAACCTA	TAAAAATAGG	CGTAGTACGA	GGCCCTTTCA	CTCATTAGAT
61	GCATGTCGTT	ACATAACTTA	CGGTAAATGG	CCCGCCTGGC	TGACCGCCCA	ACGACCCCCG
121	CCCATTGACG	TCAATAATGA	CGTATGTTCC	CATAGTAACG	CCAATAGGGA	CTTTCCATTG
181	ACGTCAATGG	GTGGAGTATT	TACGGTAAAC	TGCCCACTTG	GCAGTACATC	AAGTGTATCA
241	TATGCCAAGT	ACGCCCCCTA	TTGACGTCAA	TGACGGTAAA	TGGCCCGCCT	GGCATTATGC
301	CCAGTACATG	ACCTTATGGG	ACTTTCCTAC	TTGGCAGTAC	ATCTACGTAT	TAGTCATCGC
361	TATTACCATG	GTGATGCGGT	TTTGGCAGTA	CATCAATGGG	CGTGGATAGC	GGTTTGACTC
421	ACGGGGATTT	CCAAGTCTCC	ACCCCATTTGA	CGTCAATGGG	AGTTTGTTTT	GGCACCAAAA
481	TCAACGGGAC	TTTCCAAAAT	GTCGTAACAA	CTCCGCCCCA	TTGACGCAAA	TGGGCGGTAG
541	GCGTGTACGG	TGGGAGGTCT	ATATAAGCAG	AGCTCGTTTA	GTGAACCGTC	AGATCGCCTG
601	GAGACGCCAT	CCACGCTGTT	TTGACCTCCA	TAGAAGACAC	CGGGACCGAT	CCAGCCTCCG
661	GACTCTAGCC	TAGGCCGCGG	AGCGGATAAC	AATTTTCACAC	AGGAAACAGC	TATGACCATT
721	AGGCCTTTGC	AAAAAGCTAT	TTAGGTGACA	CTATAGAAGG	TACGCCTGCA	GGTACCGGAT
781	CACAAGTTTG	TACAAAAAAG	CTGAACGAGA	AACGTAAAAT	GATATAAATA	TCAATATATT
841	AAATTAGATT	TTGCATAAAA	AACAGACTAC	ATAATACTGT	AAAACACAAC	ATATCCAGTC
901	ACTATGGCGG	CCGCATTAGG	CACCCACGGC	TTTACACTTT	ATGCTTCCGG	CTCGTATAAT
961	GTGTGGATTT	TGAGTTAGGA	TCCGTCGAGA	TTTTCAGGAG	CTAAGGAAGC	TAAAATGGAG
1021	AAAAAATCA	CTGGATATAC	CACCGTTGAT	ATATCCCAAT	GGCATCGTAA	AGAACATTTT
1081	GAGGCATTTT	AGTCAGTTGC	TCAATGTACC	TATAACCAGA	CCGTTTCAGCT	GGATATTACG
1141	GCCTTTTTAA	AGACCGTAAA	GAAAAATAAG	CACAAGTTTT	ATCCGGCCTT	TATTCACATT
1201	CTTGCCCGCC	TGATGAATGC	TCATCCGGAA	TTCCGTATGG	CAATGAAAGA	CGGTGAGCTG
1261	GTGATATGGG	ATAGTGTTCA	CCCTTGTTAC	ACCGTTTTCC	ATGAGCAAAC	TGAAACGTTT
1321	TCATCGCTCT	GGAGTGAATA	CCACGACGAT	TTCCGGCAGT	TTCTACACAT	ATATTCGCAA
1381	GATGTGGCGT	GTTACGGTGA	AAACCTGGCC	TATTTCCCTA	AAGGGTTTTAT	TGAGAATATG
1441	TTTTTCGTCT	CAGCCAATCC	CTGGGTGAGT	TTCACCAGTT	TTGATTTAAA	CGTGGCCAAT
1501	ATGGACAAC	TCTTCGCCCC	CGTTTTTACC	ATGGGCAAA	ATTATACGCA	AGGCGACAAG
1561	GTGCTGATGC	CGCTGGCGAT	TCAGGTTTAT	CATGCCGTCT	GTGATGGCTT	CCATGTCGGC
1621	AGAATGCTTA	ATGAATTACA	ACAGTACTGC	GATGAGTGGC	AGGGCGGGGC	GTAACGCGCT
1681	GGATCCGGCT	TACTAAAAGC	CAGATAACAG	TATGCGTATT	TGCGCGCTGA	TTTTTGCGGT
1741	ATAAGAATAT	ATACTGATAT	GTATACCCGA	AGTATGTCAA	AAAGAGGTGT	GCTATGAAGC
1801	AGCGTATTAC	AGTGACAGTT	GACAGCGACA	GCTATCAGTT	GCTCAAGGCA	TATATGATGT
1861	CAATATCTCC	GGTCTGGTAA	GCACAACCAT	GCAGAATGAA	GCCCGTCGTC	TGCGTGCCGA
1921	ACGCTGGAAA	GCGGAAAATC	AGGAAGGGAT	GGCTGAGGTC	GCCCGGTTTA	TTGAAATGAA
1981	CGGCTCTTTT	GCTGACGAGA	ACAGGGACTG	GTGAAATGCA	GTTTAAGGTT	TACACCTATA
2041	AAAGAGAGAG	CCGTTATCGT	CTGTTTGTGG	ATGTACAGAG	TGATATTATT	GACACGCCCG
2101	GGCGACGGAT	GGTGATCCCC	CTGGCCAGTG	CACGTCTGCT	GTCAGATAAA	GTCTCCCGTG
2161	AACTTTACCC	GGTGGTGCAT	ATCGGGGATG	AAAGCTGGCG	CATGATGACC	ACCGATATGG
2221	CCAGTGTGCC	GGTCTCCGTT	ATCGGGGAAG	AAGTGGCTGA	TCTCAGCCAC	CGCGAAAATG
2281	ACATCAAAAA	CGCCATTAAC	CTGATGTTCT	GGGGAATATA	AATGTCAGGC	TCCCTTATAC
2341	ACAGCCAGTC	TGCAGGTGCA	CCATAGTGAC	TGGATATGTT	GTGTTTTACA	GTATTATGTA
2401	GTCTGTTTTT	TATGCAAAAT	CTAATTTAAT	ATATTGATAT	TTATATCATT	TTACGTTTCT
2461	CGTTCAGCTT	TCTTGTAACA	AGTGGTGATC	GCGTGCATGC	GACGTCATAG	CTCTCTCCCT
2521	ATAGTGAGTC	GTATTATAAG	CTAGGCACTG	GCCGTCGTTT	TACAACGTCG	TGACTGGGAA

2581 AACTGCTAGC TTGGGATCTT TGTGAAGGAA CCTTACTTCT GTGGTGTGAC ATAATTGGAC
2641 AAACCTACCTA CAGAGATTTA AAGCTCTAAG GTAAATATAA AATTTTTTAAG TGTATAATGT
2701 GTTAAACTAG CTGCATATGC TTGCTGCTTG AGAGTTTTGC TTAGTGAGTA TGATTTATGA
2761 AAATATTATA CACAGGAGCT AGTGATTCTA ATTGTTTGTG TATTTTAGAT TCACAGTCCC
2821 AAGGCTCATT TCAGGCCCTT CAGTCCTCAC AGTCTGTTCA TGATCATAAT CAGCCATACC
2881 ACATTGTAG AGGTTTTACT TGCTTTAAAA AACCTCCAC ACCTCCCCCT GAACCTGAAA
2941 CATAAATGA ATGCAATTGT TGTGTAAAC TTGTTTATTG CAGCTTATAA TGGTTACAAA
3001 TAAAGCAATA GCATCACAAA TTTCACAAAT AAAGCATTTT TTCACTGCA TTCTAGTTGT
3061 GGTGTGTCCA AACTCATCAA TGTATCTTAT CATGTCTGGA TCGATCCTGC ATTAATGAAT
3121 CGGCCAACGC GCGGGGAGAG GCGGTTTGCG TATTGGCTGG CGTAATAGCG AAGAGGCCCG
3181 CACCGATCGC CCTTCCCAAC AGTTGCGCAG CCGTAATGGC GAATGGGACG CGCCCTGTAG
3241 CGGCGCATT AGCGCGCGG GTGTGGTGGT TACGCGCAGC GTGACCGCTA CACTTGCCAG
3301 CGCCCTAGCG CCCGCTCCTT TCGCTTTCTT CCCTTCCTTT CTCGCCACGT TCGCCGGCTT
3361 TCCCCGTCAA GCTCTAAATC GGGGGCTCCC TTAGGGTTC CGATTTAGTG CTTTACGGCA
3421 CCTCGACCCC AAAAACTTG ATTAGGGTGA TGGTTCACGT AGTGGGCCAT CGCCCTGATA
3481 GACGGTTTTT CGCCCTTTGA CGTTGGAGTC CACGTTCTTT AATAGTGGAC TCTTGTTCCTA
3541 AACTGGAACA AACTCAACC CTATCTCGGT CTATCTCTTT GATTTATAAG GGATTTTGCC
3601 GATTTCGGCC TATTGGTTAA AAAATGAGCT GATTTAACAA AAATTTAAC CGAATTTTAA
3661 CAAAATATTA ACGTTTACAA TTTAGGTGG CACTTTTCGG GGAAATGTGC GCGGAACCCC
3721 TATTTGTTTA TTTTCTAAA TACATTCAA TATGTATCCG CTCATGCCAG GTCTTGGACT
3781 GGTGAGAACG GCTTGCTCGG CAGCTTCGAT GTGTGCTGGA GGGAGAATAA AGGTCTAAGA
3841 TGTGCGATAG AGGGAAGTCG CATTGAATTA TGTGCTGTGT AGGGATCGCT GGTATCAAT
3901 ATGTGTGCCC ACCCTTGGCA TGAGACAATA ACCCTGATAA ATGCTTCAAT AATATTGAAA
3961 AAGGAAGAGT ATGAGTATTC AACATTTCCG TGTCGCCCTT ATTCCTTTT TTGCGGCATT
4021 TTGCCTTCTT GTTTTGTCTC ACCCAGAAAC GCTGGTGAAG GTAAAAGATG CTGAAGATCA
4081 GTTGGGTGCA CGAGTGGGTT ACATCGAAT GGATCTCAAC AGCGGTAAGA TCCTTGAGAG
4141 TTTTCGCCCC GAAGAACGTT TTCCAATGAT GAGCACTTTT AAAGTTCTGC TATGTGGCGC
4201 GGTATTATCC CGTATTGACG CCGGGCAAGA GCAACTCGGT CGCCGCATAC ACTATTCTCA
4261 GAATGACTTG GTTGAGTACT CACCAGTCAC AGAAAAGCAT CTTACGGATG GCATGACAGT
4321 AAGAGAATTA TGCAGTGCTG CCATAACCAT GAGTGATAAC ACTGCGGCCA ACTTACTTCT
4381 GACAACGATC GGAGGACCGA AGGAGCTAAC CGCTTTTTTG CACAACATGG GGGATCATGT
4441 AACTCGCCTT GATCGTTGGG AACCGGAGCT GAATGAAGCC ATACCAAACG ACGAGCGTGA
4501 CACCACGATG CCTGTAGCAA TGGCAACAAG GTTGCGCAAA CTATTAAC TGCGAAGTACT
4561 TACTCTAGCT TCCCGCAAC AATTAATAGA CTGGATGGAG GCGGATAAAG TTGCAAGACC
4621 ACTTCTGCGC TCGGCCCTTC CGGCTGGCTG GTTTATTGCT GATAAATCTG GAGCCGGTGA
4681 GCGTGGGTCT CGCGGTATCA TTGCAGCACT GGGGCCAGAT GGTAAGCCCT CCCGTATCGT
4741 AGTTATCTAC ACGACGGGGA GTCAGGCAAC TATGGATGAA CGAAATAGAC AGATCGCTGA
4801 GATAGTGCC TCACTGATTA AGCATTGGTA ACTGTCAGAC CAAGTTTACT CATATATACT
4861 TTAGATTGAT TTAAACTTC ATTTTAAATT TAAAAGGATC TAGGTGAAGA TCCTTTTTGA
4921 TAATCTCATG CCATAACTTC GTATAATGTA TGCTATACGA AGTTATGGCA TGACCAAAT
4981 CCCTTAACGT GAGTTTTCGT TCCACTGAGC GTCAGACCCC GTAGAAAAGA TCAAAGGATC
5041 TTCTTGAGAT CCTTTTTC TGCGCGTAAT CTGCTGTGCT CAAACAAAAA AACCACCGCT
5101 ACCAGCGGTG GTTTGTTTGC CGGATCAAGA GCTACCACT CTTTTTCCGA AGGTAACCTG
5161 CTTCAGCAGA GCGCAGATAC CAAATACTGT CCTTCTAGTG TAGCCGTAGT TAGGCCACCA
5221 CTTCAAGAAC TCTGTAGCAC CGCCTACATA CCTCGCTCTG CTAATCCTGT TACCAGTGGC
5281 TGCTGCCAGT GCGGATAAGT CGTGTCTTAC CGGTTTGGAC TCAAGACGAT AGTTACCGGA
5341 TAAGCGCAG CGGTCGGGCT GAACGGGGGG TTCGTGCACA CAGCCCAGCT TGGAGCGAAC
5401 GACCTACACC GAACGTAGAT ACCTACAGCG TGAGCATTGA GAAAGCGCCA CGCTTCCCGA
5461 AGGGAGAAAG GCGGACAGGT ATCCGGTAAG CCGCAGGGT GGAACAGGAG AGCGCACGAG
5521 GAGAGCTTCCA GGGGGAACG CCGGTATCT TTATAGTCTT CTCGGTTTTC GCCACCTCTG
5581 ACTTGAGCGT CGATTTTGTG GATGCTCGTC AGGGGGGCGG AGCCTATGGA AAAACGCCAG
5641 CAACGCGGCC TTTTACGGT TCCTGGCCTT TTGCTGGCCT TTTGCTCACA TGTTCTTTCC
5701 TGCGTTATCC CCTGATTCTG TGGATAACCG TATTACCGCC TTTGAGTGAG CTGATACCGC
5761 TCGCCGACG CGAACGACCG AGCGCAGCGA GTCAGTGAGC GAGGAAGCGG AAGAGCGCCC
5821 AATACGCAAA CCGCTCTCC CCGCGGTTTG GCCGATTCT TAATGCAGAG CTTGCAATT
5881 GCGCGTTTTT CAATATTATT GAAGCATTTA TCAGGGTTAT TGTCTCATGA GCGGATACAT
5941 ATTTGAATGT ATTTAGAAAA ATAAACAAAT AGGGGTTCCG CGCACATTTT CCCGAAAAGT
6001 GCCACCTGAC GTCTAAGAAA CCATT

Figure 28A: pDEST8 Polyhedron Promoter, Baculovirus Transfer Plasmid

AceI

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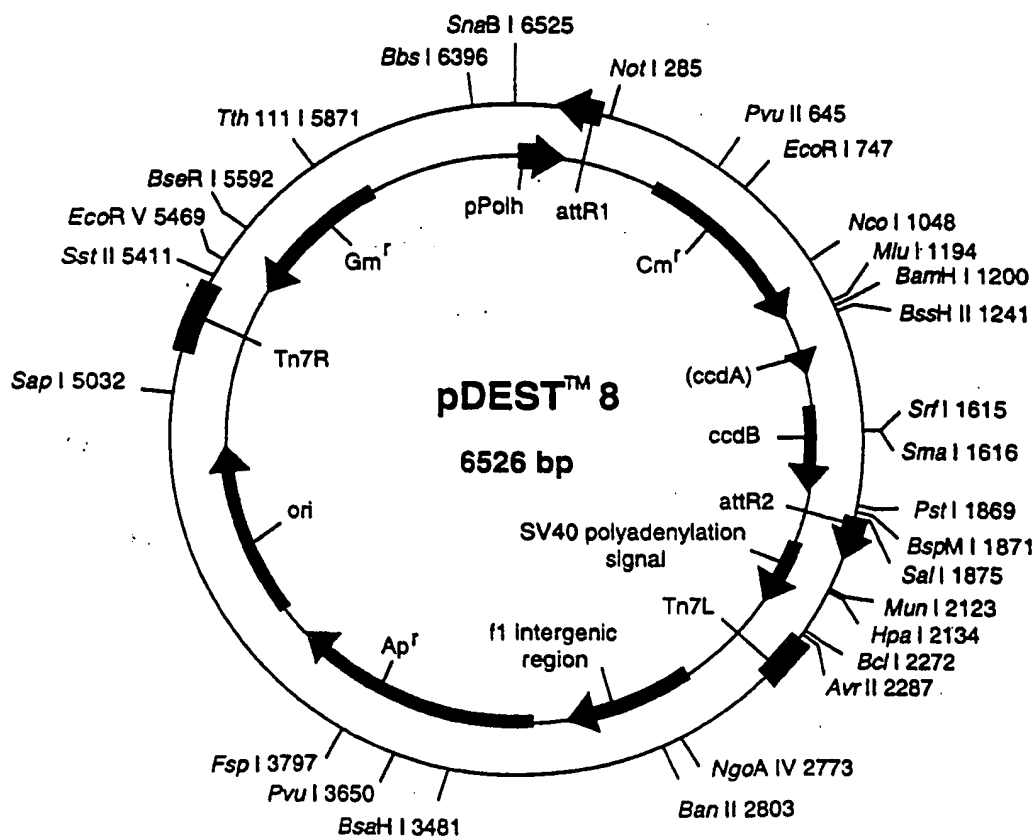
1  cgt|ata ctc cgg aat att aat aga tca tgg aga taa tta aaa tga taa cca
   gca tat gag gcc tta taa tta tct agt acc tct att aat ttt act att ggt
52  tct cgc aaa taa ata agt att tta ctg ttt tgg taa cag ttt tgt aat aaa
   aga gcg ttt att tat tca taa aat gac aaa agc att gtc aaa aca tta ttt
103 aaa acc tat aaa tat tcc gga tta ttc ata cgg tcc cac cat cgg gcg cgg
   ttt tgg ata ttt ata agg cct aat aag tat ggc agg gtg gta gcc cgc gcc
154 atc atc aca agt tgg tac gaa gaa gct gaa cga gaa aag taa aat gat ata
   tag tag tgt tca aac atg ttt ttc cga ctt gct ctt tgc att tta ctg tat

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Bam

Int

attR1



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pDEST8 6526 bp

<u>Location (Base Nos.)</u>				<u>Gene Encoded</u>		
23..152				Ppolh		
284..160				attR1		
534..1193				CmR		
1313..1397				inactivated ccdA		
1535..1840				ccdB		
1881..2005				attR2		
2766..3146				f1		
3240..4090				ampR		
4289..4869				ori		
5564..6496				genR		
1	CGTATACTCC	GGAATATTAA	TAGATCATGG	AGATAATTAA	AATGATAACC	ATCTCGCAAA
61	TAAATAAGTA	TTTTACTGTT	TTCGTAACAG	TTTTGTAATA	AAAAAACCTA	TAAATATTCC
121	GGATTATTCA	TACCGTCCCA	CCATCGGGCG	CGGATCATCA	CAAGTTTGTG	CAAAAAAGCT
181	GAACGAGAAA	CGTAAAATGA	TATAAATATC	AATATATTAA	ATTAGATTTT	GCATAAAAAA
241	CAGACTACAT	AATACTGTAA	AACACAACAT	ATCCAGTCAC	TATGGCGGCC	GCTAAGTTGG
301	CAGCATCACC	CGACGCACTT	TGCGCCGAAT	AAATACCTGT	GACGGAAGAT	CACTTCGCAG
361	AATAAATAAA	TCCTGGTGTC	CCTGTTGATA	CCGGGAAGCC	CTGGGCCAAC	TTTTGGCGAA
421	AATGAGACGT	TGATCGGCAC	GTAAGAGGTT	CCAACTTTCA	CCATAATGAA	ATAAGATCAC
481	TACCGGGCGT	ATTTTTTGAG	TTATCGAGAT	TTTCAGGAGC	TAAGGAAGCT	AAAATGGAGA
541	AAAAAATCAC	TGGATATACC	ACCGTTGATA	TATCCCAATG	GCATCGTAAA	GAACATTTTG
601	AGGCATTTC	GTCAGTTGCT	CAATGTACCT	ATAACCAGAC	CGTTCAGCTG	GATATTACGG
661	CCTTTTTTAA	GACCGTAAAG	AAAAATAAGC	ACAAGTTTTA	TCCGGCCTTT	ATTCACATTC
721	TTGCCCGCCT	GATGAATGCT	CATCCGGAAT	TCCGTATGGC	AATGAAAGAC	GGTGAGCTGG
781	TGATATGGGA	TAGTGTTTAC	CCTTGTTTACA	CCGTTTTTCCA	TGAGCAAAC	GAAACGTTTT
841	CATCGCTCTG	GAGTGAATAC	CACGACGATT	TCCGGCAGTT	TCTACACATA	TATTTCGCAAG
901	ATGTGGCGTG	TTACGGTGAA	AACCTGGCCT	ATTTCCCTAA	AGGGTTTTATT	GAGAATATGT
961	TTTTCGTCTC	AGCCAATCCC	TGGGTGAGTT	TCACCAGTTT	TGATTTAAAC	GTGGCCAATA
1021	TGGACAACTT	CTTCGCCCCC	GTTTTTACCA	TGGGCAAATA	TTATACGCAA	GGCGACAAGG
1081	TGCTGATGCC	GCTGGCGATT	CAGGTTTCATC	ATGCCGCTCTG	TGATGGCTTC	CATGTCGGCA
1141	GAATGCTTAA	TGAATTACAA	CAGTACTGCG	ATGAGTGGCA	GGGCGGGGCG	TAAACGCGTG
1201	GATCCGGCTT	ACTAAAAGCC	AGATAACAGT	ATGCGTATTT	GCGCGCTGAT	TTTTGCGGTA
1261	TAAGAATATA	TACTGATATG	TATACCCGAA	GTATGTCAAA	AAGAGGTGTG	CTATGAAGCA
1321	GCGTATTACA	GTGACAGTTG	ACAGCGACAG	CTATCAGTTG	CTCAAGGCAT	ATATGATGTC
1381	AATATCTCCG	GTCTGGTAAG	CACAACCATG	CAGAATGAAG	CCCGTCGTCT	GCGTGCCGAA
1441	CGCTGGAAG	CGGAAAATCA	GGAAGGGATG	GCTGAGGTCG	CCCGGTTTAT	TGAAATGAAC
1501	GGCTCTTTTG	CTGACGAGAA	CAGGGACTGG	TGAAATGCAG	TTTAAGGTTT	ACACCTATAA
1561	AAGAGAGAGC	CGTTATCGTC	TGTTTGTGGA	TGTACAGAGT	GATATTATTG	ACACGCCCGG
1621	GCGACGGATG	GTGATCCCCC	TGGCCAGTGC	ACGTCTGCTG	TCAGATAAAG	TCTCCCGTGA
1681	ACTTTACCCG	GTGGTGCCAT	TCGGGGATGA	AAGCTGGCGC	ATGATGACCA	CCGATATGGC
1741	CAGTGTGCCG	GTCTCCGTTA	TCGGGGAAGA	AGTGGCTGAT	CTCAGCCACC	GCGAAAATGA
1801	CATCAAAAAC	GCCATTAACC	TGATGTTCTG	GGGAATATAA	ATGTCAGGCT	CCCTTATACA
1861	CAGCCAGTCT	GCAGGTCGAC	CATAGTGACT	GGATATGTTG	TGTTTTACAG	TATTATGTAG
1921	TCTGTTTTTT	ATGCAAAATC	TAATTTAATA	TATTGATATT	TATATCATTT	TACGTTTCTC
1981	GTTACAGCTT	CTTGTAACAA	GTGGTGATAG	CTGTCTGAGA	AGTACTAGAG	GATCATAATC
2041	AGCCATACCA	CATTTGTAGA	GGTTTTACTT	GCTTTAAAAA	ACCTCCCACA	CCTCCCCCTG
2101	AACCTGAAAC	ATAAAATGAA	TGCAATTGTT	GTTGTTAACT	TGTTTATTGC	AGCTTATAAT
2161	GGTTACAAAT	AAAGCAATAG	CATCACAAT	TTCAACAATA	AAGCATTTTT	TTCAGTGCAT
2221	TCTAGTTGTG	GTTTGTTCAA	ACTCATCAAT	GTATCTTATC	ATGTCTGGAT	CTGATCACTG
2281	CTTGAGCCTA	GGAGATCCGA	ACCAGATAAG	TGAAATCTAG	TTCCAAACTA	TTTTGTCAAT
2341	TTTAATTTTC	GTATTAGCTT	ACGACGCTAC	ACCCAGTTCC	CATCTATTTT	GTCAGTCTTC
2401	CCTAAATAAT	CCTTAAAAAC	TCCATTTCCA	CCCTCCCGAG	TTCCCAACTA	TTTTGTCCCG
2461	CCACAGCGGG	GCATTTTTCT	TCCTGTTATG	TTTTTAATCA	AACATCTGCG	CAACTCCATG
2521	TGACAAACCG	TCATCTTCGG	CTACTTTTTT	TCTGTCACAG	AATGAAAATT	TTTCTGTCAT

FIGURE 28B

2581 CTCTTCGTTA TTAATGTTTG TAATTGACTG AATATCAACG CTTATTGCA GCCTGAATGG
2641 CGAATGGACG CGCCCTGTAG CGGCGCATTG AGCGCGGCGG GTGTGGTGGT TACGCGCAGC
2701 GTGACCGCTA CACTTGCCAG CGCCCTAGCG CCCGCTCCTT TCGCTTTCTT CCCTTCCTTT
2761 CTCGCCACGT TCGCCGGCTT TCCCGTCAA GCTCTAAATC GGGGGCTCCC TTTAGGGTTC
2821 CGATTTAGTG CTTTACGGCA CCTCGACCCC AAAAACTTG ATTAGGGTGA TGGTTCACGT
2881 AGTGGGCCAT CGCCCTGATA GACGGTTTTT CGCCCTTTGA CGTTGGAGTC CACGTTCTTT
2941 AATAGTGGAC TCTTGTTCCT AACTGGAACA ACACCAACC CTATCTCGGT CTATTCTTTT
3001 GATTTATAAG GGATTTTGCC GATTTGCGCC TATTGGTTAA AAAATGAGCT GATTTAACAA
3061 AAATTTAACG CGAATTTTAA CAAAATATTA ACGTTTACAA TTTTCAGGTG CACTTTTCGG
3121 GGAAATGTGC GCGGAACCCC TATTTGTTTA TTTTCTAAA TACATTCAA TATGTATCCG
3181 CTCATGAGAC AATAACCTG ATAAATGCTT CAATAATATT GAAAAAGGAA GAGTATGAGT
3241 ATTCACATT TCCGTGTCGC CCTTATTCCT TTTTTCGCG CATTTTGCCT TCCTGTTTTT
3301 GCTCACCCAG AAACGCTGGT GAAAGTAAAA GATGCTGAAG ATCAGTTGGG TGCACGAGTG
3361 GGTTCACATG AACTGGATCT CAACAGCGGT AAGATCCTTG AGAGTTTTTCG CCCCGAAGAA
3421 CGTTTTTCAA TGATGAGCAC TTTTAAAGTT CTGCTATGTG GCGCGGTATT ATCCCGTATT
3481 GACGCCGGGC AAGAGCAACT CGGTCGCCGC ATACACTATT CTCAGAATGA CTGGTTGAG
3541 TACTACCAG TCACAGAAAA GCATCTTACG GATGGCATGA CAGTAAGAGA ATTATGCAGT
3601 GCTGCCATAA CCATGAGTGA TAACACTGCG GCCAACTTAC TTCTGACAAC GATCGGAGGA
3661 CCGAAGGAGC TAACCGCTTT TTTGCACAAC ATGGGGGATC ATGTAACCTG CCTGTATCGT
3721 TGGGAACCGG AGCTGAATGA AGCCATACCA AACGACGAGC GTGACACCAC GATGCCGTGA
3781 GCAATGGCAA CAACGTTGCG CAACTATTA ACTGGCGAAC TACTTACTCT AGCTTCCCGG
3841 CAACAATTAA TAGACTGGAT GGAGGCGGAT AAAGTTGCAG GACCATTCT GCGCTCGGCC
3901 CTTCCGGCTG GCTGGTTTAT TGCTGATAAA TCTGGAGCCG GTGAGCGTGG GTCTCGCGGT
3961 ATCATTGCAG CACTGGGGCC AGATGGTAAG CCTCCCGTA TCGTAGTTAT CTACACGACG
4021 GGGAGTCAGG CAACTATGGA TGAACGAAAT AGACAGATCG CTGAGATAGG TGCCTCACTG
4081 ATTAAGCATT GGTAACGTG AGACCAAGTT TACTCATATA TACTTTAGAT TGATTTAAAA
4141 CTTTATTTTT AATTTAAAAG GATCTAGGTG AAGATCCTTT TTGATAATCT CATGACCAAA
4201 ATCCCTTAAC GTGAGTTTTT GTTCCACTGA CGTCAGACC CCGTAGAAAA GATCAAAGGA
4261 TCTTCTTGAG ATCCTTTTTT TCTGCGCGTA ATCTGCTGCT TGCAAACAAA AAAACCACCG
4321 CTACCGCGG TGGTTTGTGTT GCCGGATCAA GAGCTACCAA CTCTTTTTCC GAAGGTAAC
4381 GGCTTCAGCA GAGCGCAGAT ACCAAATACT GTCCTTCTAG TGTAGCCGTA GTTAGGCCAC
4441 CACTTCAAGA ACTCTGTAGC ACCGCTACA TACCTCGCTC TGCTAATCCT GTTACCAGTG
4501 GCTGCTGCCA GTGGCGATAA GTCGTGTCTT ACCGGGTGG ACTCAAGACG ATAGTTACCG
4561 GATAAGGCGC AGCGGTGCGG CTGAACGGGG GGTTCGTGCA CACAGCCAG CTTGGAGCGA
4621 ACGACCTACA CCGAACTGAG ATACCTACAG CGTGAGCATT GAGAAAGCGC CACGCTTCCC
4681 GAAGGGAGAA AGGCGGACAG GTATCCGGTA AGCGGCAGGG TCGGAACAGG AGAGCGCAGC
4741 AGGGAGCTTC CAGGGGGAAG CGCCTGGTAT CTTTATAGTC CTGTGCGGTT TCGCCACCTC
4801 TGACTTGAGC GTCGATTTTT GTGATGCTCG TCAGGGGGGC GGAGCCTATG GAAAAACGCC
4861 AGCAACGCGG CCTTTTACG GTTCTGGCC TTTTGCTGGC CTTTTGCTCA CATGTTCTTT
4921 CTTGCGTTAT CCCCTGATTC TGTGGATAAC CGTATTACCG CCTTTGAGTG AGCTGATACC
4981 GCTCGCCGCA GCCGAACGAC CGAGCGCAGC GAGTCAGTGA GCGAGGAAGC GGAAGAGCGC
5041 CTGATGCGGT ATTTCTCCT TACGCATCTG TGCGGTATTT CACACCGCAG ACCAGCCGCG
5101 TAACCTGGCA AAATCGGTTA CGGTTGAGTA ATAAATGGAT GCCCTGCGTA AGCGGTGTG
5161 GGCGGACAAT AAAGTCTTAA ACTGAACAAA ATAGATCTAA ACTATGACAA TAAAGTCTTA
5221 AACTAGACAG AATAGTTGTA AACTGAAATC AGTCCAGTTA TGCTGTGAAA AAGCATACTG
5281 GACTTTTGTT ATGGCTAAAG CAACTCTTC ATTTCTGAA GTGCAAATTG CCCGTCGTAT
5341 TAAAGAGGGG CGTGGCCAAG GGCATGGTAA AGACTATATT CGCGGCGTTG TGACAATTTA
5401 CCGAACAACT CCGCGGCCGG GAAGCCGATC TCGGCTTGAA CGAATTGTTA GGTGGCGGTA
5461 CTTGGGTGCA TATCAAAGTG CATCACTTCT TCCCGTATGC CCAACTTTGT ATAGAGAGCC
5521 ACTGCGGGAT CGTCACCGTA ATCTGCTTGC ACGTAGATCA CATAAGCACC AAGCGCGTTG
5581 GCCTCATGCT TGAGGAGATT GATGAGCGCG GTGGCAATGC CCTGCCTCCG GTGCTCGCCG
5641 GAGACTGCGA GATCATAGAT ATAGATCTCA CTACGCGGCT GCTCAAACCT GGGCAGAACG
5701 TAAGCCGCGA GAGCGCCAAC AACCGCTTCT TGGTCAAGG CAGCAAGCGC GATGAATGTC
5761 TTACTIONGCA GCAAGTCCCC GAGGTAATCG GAGTCCGGCT GATGTTGGGA GTAGGTGGCT
5821 ACGTCTCCGA ACTCACGACC GAAAAGATCA AGAGCAGCCC GCATGGATTT GACTTGGTCA
5881 GGGCCGAGCC TACATGTGCG AATGATGCCC ATACTTGAGC CACCTAACTT TGTTTTAGGG
5941 CGACTGCCCT GCTGCGTAAC ATCGTTGCTG CTGCGTAACA TCGTTGCTGC TCCATAACAT
6001 CAAACATCGA CCCACGGCGT AACGCGCTTG CTGCTTGGAT GCGCGAGGCA TAGACTGTAC

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6061 AAAAAACAG TCATAACAAG CCATGAAAAC CGCCACTGCG CCGTTACCAC CGCTGCGTTC
6121 GGTCAAGGTT CTGGACCACT TGCCTGAGCG CATACGCTAC TTGCATTACA GTTTACGAAC
6181 CGAACAGGCT TATGTCAACT GGGTTCGTGC CTTTCATCCGT TTCCACGGTG TCGGTCACCC
6241 GGCAACCTTG GGCAGCAGCG AAGTCGAGGC ATTTCTGTCC TGGCTGGCGA ACGAGCGCAA
6301 GGTTCGGTC TCCACGCATC GTCAGGCATT GGCGGCCTTG CTGTTCTTCT ACGGCAAGGT
6361 GCTGTGCACG GATCTGCCCT GGCTTCAGGA GATCGGAAGA CCTCGGCCGT CGCGGCGCTT
6421 GCCGGTGGTG CTGACCCCGG ATGAAGTGGT TCGCATCCTC GGTTTTCTGG AAGGCGAGCA
6481 TCGTTTGTTT GCCCAGGACT CTAGCTATAG TTCTAGTGGT TGGCTA

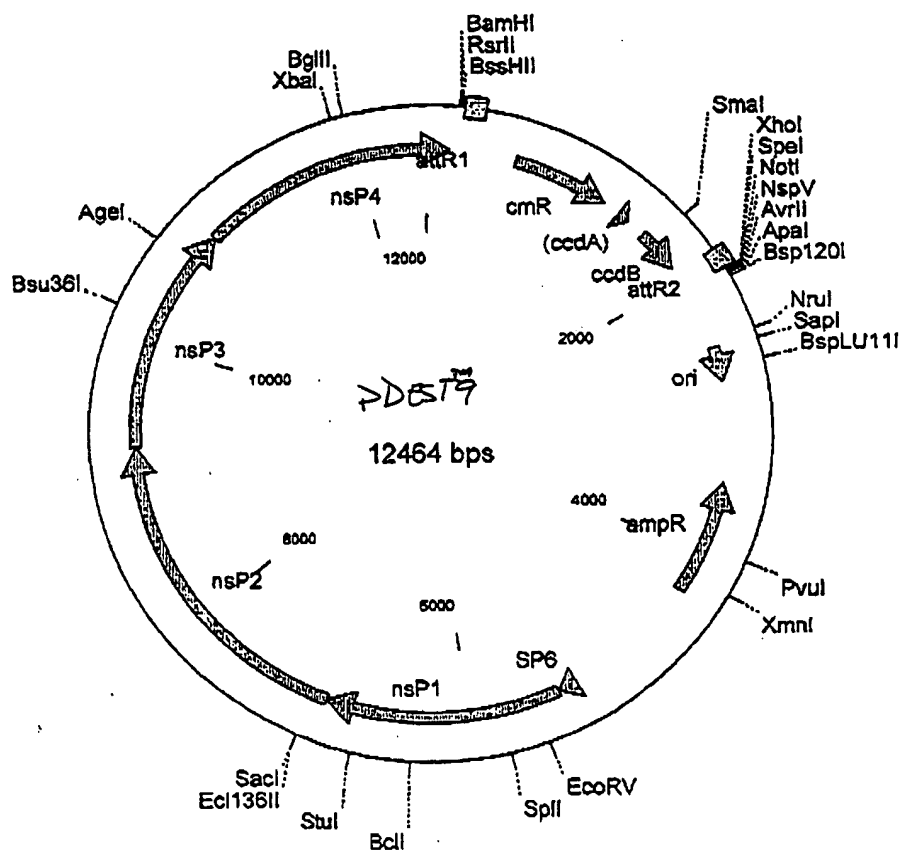
FIGURE 28D

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Figure 29A: pDEST9

Semliki Forest Virus vector

103 ttg gcg agg gac att aag gcg ttt aag aaa ttg aga gga cct gtt ata cat
 aac cgc tcc ctg taa ttc cgc aaa ttc ttt aac tct cct gga caa tat gtg
 243 ccmR 265 RNA
 154 ctc tac ggc ggt cct aga ttg gtc cgt taa tac aca gaa ttc tga ttg gat
 gag atg ccg cca gga tct aac cac gca att atg tgt ctt aag act aac cta
 Rsr II Frt att R1
 205 ccc ggt ccg aag cgc gct ttc cca tca aca agt tgc tac aac aag gct gaa
 ggg cca ggc ttc gcg cga aag ggt agt tgt tca aac atg ttt ttc cga att



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pDEST9 12464 bp

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
355..232	attR1
605..1264	CmR
1384..1468	inactivated ccdA
1606..1911	ccdB
1952..2078	attR2
2532..2782	ori
3482..4282	ampR
5232..5365	SP6 promoter
5365..6965	nsP1:non-structural protein 1
6965..9265	nsP2:non-structural protein 2
9265..10865	nsP3:non-structural protein 3
10865..161	nsP4:non-structural protein 4

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1 AGCAAGTGGT TCCGGACAGG CTTGGGGGCC GAACTGGAGG TGGCACTAAC ATCTAGGTAT
61 GAGGTAGAGG GCTGCAAAAG TATCCTCATA GCCATGGCCA CCTTGGCGAG GGACATTAAG
121 GCGTTTAAAG AATTGAGAGG ACCTGTTATA CACCTCTACG GCGGTCCCTAG ATTGGTGCGT
181 TAATACACAG AATTCTGATT GGATCCCGGT CCGAAGCGCG CTTTCCCATC ACAAGTTTGT
241 ACAAAAAAGC TGAACGAGAA ACGTAAATG ATATAAATAT CAATATATTA AATTAGATT
301 TGCATAAAAA ACAGACTACA TAATACTGTA AAACACAACA TATCCAGTCA CTATGGCGGC
361 CGCTAAGTTG GCAGCATCAC CCGACGCACT TTGCGCCGAA TAAATACCTG TGACGGAAGA
421 TCACTTCGCA GAATAAATAA ATCCTGGTGT CCCTGTTGAT ACCGGGAAGC CCTGGGCCAA
481 CTTTTGGCGA AAATGAGACG TTGATCGGCA CGTAAGAGGT TCCAACCTTC ACCATAATGA
541 AATAAGATCA CTACCGGGCG TATTTTTTGA GTTATCGAGA TTTTCAGGAG CTAAGGAAGC
601 TAAAATGGAG AAAAAAATCA CTGGATATAC CACCGTTGAT ATATCCCAAT GGCATCGTAA
661 AGAACATTTT GAGGCATTTT AGTCAGTTGC TCAATGTACC TATAACCAGA CCGTTCAGCT
721 GGATATTACG GCCTTTTTAA AGACCGTAAA GAAAAATAAG CACAAGTTT ATCCGGCCTT
781 TATTCACATT CTTGCCCCGC TGATGAATGC TCATCCGGA TCCGTATGG CAATGAAAGA
841 CGGTGAGCTG GTGATATGGG ATAGTGTTCA CCCTTGTTAC ACCGTTTTCC ATGAGCAAAC
901 TGAAACGTTT TCATCGCTCT GGAGTGAATA CCACGACGAT TTCCGGCAGT TTCTACACAT
961 ATATTCGCAA GATGTGGCGT GTTACGGTGA AAACCTGGCC TATTTCCCTA AAGGGTTTAT
1021 TGAGAATATG TTTTTCGTCT CAGCCAATCC CTGGGTGAGT TTCACCAGT TTGATTTAAA
1081 CGTGGCCAAT ATGGACAACT TCTTCGCCCC CGTTTTTACC ATGGGCAAAT ATTATACGCA
1141 AGGCGACAAG GTGCTGATGC CGCTGGCGAT TCAGGTTCAT CATGCCGTCT GTGATGGCTT
1201 CCATGTCCGC AGAATGCTTA ATGAATTACA ACAGTACTGC GATGAGTGGC AGGGCGGGGC
1261 GTAAAGATCT GGATCCGGCT TACTAAAAGC CAGATAACAG TATGCGTATT TGCGCGCTGA
1321 TTTTTCGGT ATAAGAATAT ATACTGATAT GTATACCCGA AGTATGTCAA AAAGAGGTGT
1381 GCTATGAAGC AGCGTATTAC AGTGACAGT GACAGCGACA GCTATCAGT GCTCAAGGCA
1441 TATATGATGT CAATATCTCC GGTCTGGTAA GCACAACCAT GCAGAATGAA GCCCGTCGTC
1501 TGGCTGCCGA ACGCTGGAAA GCGGAAAATC AGGAAGGGAT GGCTGAGGTC GCCCGGTTTA
1561 TTGAAATGAA CGGCTCTTTT GCTGACGAGA ACAGGGACTG GTGAAATGCA GTTTAAGGTT
1621 TACACCTATA AAAGAGAGAG CCGTTATCGT CTGTTTGTGG ATGTACAGAG TGATATTATT
1681 GACACGCCCC GCGACGGAT GGTGATCCCC CTGGCCAGTG CACGTCTGCT GTCAGATAAA
1741 GTCTCCCGTG AACTTTACCC GGTGGTGCAT ATCGGGGATG AAAGCTGGCG CATGATGACC
1801 ACCGATATGG CCAGTGTGCC GGTCTCCGTT ATCGGGGAAG AAGTGGCTGA TCTCAGCCAC
1861 CGCGAAAATG ACATCAAAAA CGCCATTAAAC CTGATGTTCT GGGGAATATA AATGTCAGGC
1921 TCCCTTATAC ACAGCCAGTC TGCAGGTCGA CCATAGTGAC TGGATATGTT GTGTTTTACA
1981 GTATTATGTA GTCTGTTTTT TATGCAAAAG TGCTAATTTA ATATATTGAT ATTTATATCA
2041 TTTTACGTTT CTCGTTACGC TTTCTTGTA AAAGTGGTGA TGGGAACCTG AGTTCACTAG
2101 TCGATCCCGC GGCCGCTTTC GAACCTAGGC AAGCATGCGG GCCCAGTGGG TAATTAATTG
2161 AATTACATCC CTACGCAAAC GTTTTACGGC CGCCGGTGGC GCCCGCGCCC GGCGGCCCGT
2221 CCTTGGCCGT TGCAGGCCAC TCCGGTGGCT CCCGTCGTCC CCGACTTCCA GGCCAGCAG
2281 ATGCAGCAAC TCATCAGCGC CGTAAATGCG CTGACAATGA GACAGAACGC AATTGCTCCT
2341 GCTAGGAGCT TAATTCGACG AATAATTGGA TTTTATTITT ATTTTGCAAT TGGTTTTTAA
2401 TATTTCCAAA AAAAAAAAAA AAAAAAAAAA AAAAAAAAAA AAAAAAAAAA AAAAAAAAAA

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FIGURE 29B

2461 AAAAAAAAAA AAAAAAACTA GAAATCGCGA TTTCTAGTCT GCATTAATGA ATCGGCCAAC
2521 GCGCGGGGAG AGGCGGTTTG CGTATTGGGC GCTCTTCCGC TTCCTCGCTC ACTGACTCGC
2581 TGCGCTCGGT CGTTCGGCTG CGGCGAGCGG TATCAGCTCA CTCAAAGGCG STAATACGGT
2641 TATCCACAGA ATCAGGGGAT AACGCAGGAA AGAACATGTG AGCAAAAGGC CAGCAAAAGG
2701 CCAGGAACCG TAAAAAGGCC GCGTTGCTGG CGTTTTTCCA TAGGCTCCGC CCCCTGACG
2761 AGCATCACAA AAATCGACGC TCAAGTCAGA GGTGGCGAAA CCCGACAGGA CTATAAAGAT
2821 ACCAGGCGTT TCCCCCTGGA AGCTCCCTCG TGCGCTCTCC TGTTCCGACC CTGCCGCTTA
2881 CCGGATACCT GTCCGCCTTT CTCCCTTCGG GAAGCGTGGC GCTTTCTCAA TGCTCGCGCT
2941 GTAGGTATCT CAGTTCGGTG TAGGTCGTTT GCTCCAAGCT GGGCTGTGTG CACGAACCCC
3001 CCGTTCAGCC CGACCGCTGC GCGTTATCCG GTAACATCG TCTTGAGTCC AACCCGGTAA
3061 GACACGACTT ATCGCCACTG GCAGCAGCCA CTGGTAACAG GATTAGCAGA GCGAGGTATG
3121 TAGGCGGTGC TACAGAGTTC TTGAAGTGGT GGCCTAACTA CGGCTACACT AGAAGGACAG
3181 TATTTGGTAT CTGCGCTCTG CTGAAGCCAG TTACCTTCGG AAAAAGAGTT GGTAGCTCTT
3241 GATCCGGCAA ACAAAACCACC GCTGGTAGCG GTGGTTTTTT TGTTTGCAAG CAGCAGATTA
3301 CGCGCAGAAA AAAAGGATCT CAAGAAGATC CTTTGATCTT TTCTACGGGG TCTGACGCTC
3361 AGTGAACGA AAATCACGT TAAGGGATTT TGGTCATGAG ATTATCAAAA AGGATCTTCA
3421 CCTAGATCCT TTAAATTAA AAATGAAGTT TAAATCAAT CTAAAGTATA TATGAGTAAA
3481 CTTGGTCTGA CAGTTACCAA TGCTTAATCA GTGAGGCACC TATCTCAGCG ATCTGTCTAT
3541 TTCGTTTCATC CATAGTTGCC TGACTCCCGG TCGTGTAGAT AACTACGATA CGGGAGGGCT
3601 TACCATCTGG CCCAGTGCT GCAATGATAC CGCGAGACCC ACGCTCACC GCTCCAGATT
3661 TATCAGCAAT AAACCAGCCA GCCGGAAGGG CCGAGCGCAG AAGTGGTCCT GCAACTTTAT
3721 CCGCCTCCAT CCAGTCTATT AATTGTTGCC GGAAGCTAG AGTAAGTAGT TCGCCAGTTA
3781 ATAGTTTGGC CAACGTTGTT GCCATTGCTA CAGGCATCGT GGTGTCACGC TCGTCGTTTG
3841 GTATGGCTTC ATTCAGCTCC GGTTCCCAAC GATCAAGGCG AGTTACATGA TCCCCATGT
3901 TGTGCAAAAA AGCGGTTAGC TCCTTCGGTC CTCCGATCGT TGTCAGAAGT AAGTTGGCCG
3961 CAGTGTTATC ACTCATGGTT ATGGCAGCAC TGCATAATTC TCTTACTGTC ATGCCATCCG
4021 TAAGATGCTT TTCTGTGACT GGTGAGTACT CAACCAAGTC ATTCTGAGAA TAGTGTATGC
4081 GCGGACCGAG TTGCTCTTGC CCGGCGTCAA TACGGGATAA TACCGCGCCA CATAGCAGAA
4141 CTTTAAAGT GCTCATCATT GGAACACGTT CTTGCGGGCG AAAACTCTCA AGGATCTTAC
4201 CGCTGTTGAG ATCCAGTTCG ATGTAACCCA CTCGTGCACC CAACTGATCT TCAGCATCTT
4261 TTACTTTCAC CAGCGTTTCT GGGTGAGCAA AAACAGGAAG GCAAAATGCC GCAAAAAAGG
4321 GAATAAGGGC GACACGAAA TGTTGAATAC TCATACTCTT CCTTTTCAA TATTATTGAA
4381 GCATTTATCA GGGTTATTGT CTCATGAGCG GATACATATT TGAATGTATT TAGAAAAATA
4441 AACAAATAGG GGTTCGCGC ACATTTCCCC GAAAAGTGCC ACCTGACGTC TAAGAAACCA
4501 TTATTATCAT GACATTAACC TATAAAAATA GCGGTATCAC GAGGCCCTTT CGTCTCGCGC
4561 GTTTCGGTGA TGACGGTGAA AACCTCTGAC ACATGCAGCT CCCGGAGACG GTCACAGCTT
4621 CTGTCTAAGG GGATGCCGGG AGCAGACAAG CCCGTCAGGG CCGGTCAGCG GGTGTTGGCG
4681 GGTGTCGGGG CTGGCTTAAC TATGCGGAGT CAGAGCAGAT TGTACTGAGA GTGCACCATA
4741 TCGACGCTCT CCCTTATGCG ACTCCTGCAT TAGGAAGCAG CCCAGTACTA GGTGAGGCC
4801 GTTGAGCACC GCCGCCGCAA GGAATGGTGC ATGCAAGGAG ATGGCGCCCA ACAGTCCCCC
4861 GGCCACGGGG CCTGCCACCA TACCCACGCC GAAACAAGCG CTCATGAGCC CGAAGTGGCG
4921 AGCCCGATCT TCCCCATCGG TGATGTCGGC GATATAGGCG CCAGCAACCG CACCTGTGGC
4981 GCCGGTGATG CCGGCCACGA TGCGTCCGGC GTAGAGGATC TGGCTAGCGA TGACCCTGCT
5041 GATTGGTTTC CTGACCATT TCCGGGTGCG GAACGGCGTT ACCAGAACT CAGAAGGTTT
5101 GTCCAACCAA ACCGACTCTG ACGGCAGTTT ACGAGAGAGA TGATAGGGTC TGCTTCAGTA
5161 AGCCAGATGC TACACAATTA GGCTTGTA TATTGTCGTT AGAACGCGG TACAATTAAT
5221 ACATAACCTT ATGTATCATA CACATACGAT TTAGTGACA CTATAGATGG CGGATGTGTG
5281 ACATACACGA CGCCAAAGA TTTTGTTCCTA GCTCCTGCCA CCTCCGCTAC GCGAGAGATT
5341 AACCACCCAC GATGGCCGCC AAAGTGCATG TTGATATTGA GGCTGACAGC CCATTCATCA
5401 AGTCTTTGCA GAAGGCATTT CCGTCGTTTC AGGTGGAGTC ATTGCAGGTC ACACCAAATG
5461 ACCATGCAAA TGCCAGAGCA TTTTCGCACC TGGCTACCAA ATTGATCGAG CAGGAGACTG
5521 ACAAAGACAC ACTCATCTTG GATATCGGCA GTGCGCCTTC CAGGAGAATG ATGTCTACGC
5581 ACAAATACCA CTGCGTATGC CCTATGCGCA GCGCAGAAGA CCCCAGAAAG CTGATAGCT
5641 ACGCAAAGAA ACTGGCAGCG GCCTCCGGGA AGGTGCTGGA TAGAGAGATC GCAGGAAAAA
5701 TCACCGACCT GCAGACCGTC ATGGCTACGC CAGACGCTGA ATCTCCTACC TTTTGCCTGC
5761 ATACAGACGT CACGTGTCGT ACGGCAGCCG AAGTGGCCGT ATACCAGGAC GTGTATGCTG
5821 TACATGCACC AACATCGCTG TACCATCCG CGATGAAAGG TGTGAGAAGC GCGTATTGGA
5881 TTGGGTTTGA CACCACCCG TTTATGTTTG ACGCGCTAGC AGGCGCGTAT CCAACCTACG-

5941 CCACAAACTG GGCCGACGAG CAGGTGTTAC AGGCCAGGAA CATAGGACTG TGTGCAGCAT
6001 CCTTGACTGA GGAAGACTC GGCAAACTGT CCATTCTCCG CAAGAAGCAA TTGAAACCTT
6061 GCGACACAGT CATGTTCTCG GTAGGATCTA CATTGTACAC TGAGAGCAGA AAGCTACTGA
6121 GGAGCTGGCA CTTACCCTCC GTATTCCACC TGAAAGGTAA ACAATCCTTT ACCTGTAGGT
6181 GCGATACCAT CGTATCATGT GAAGGGTACG TAGTTAAGAA AATCACTATG TGCCCCGGCC
6241 TGTACGGTAA AACGGTAGGG TACGCCGTGA CGTATCACGC GGAGGGATTG CTAGTGTGCA
6301 AGACCACAGA CACTGTCAAA GGAGAAAGAG TCTCATTCCT TGTATGCACC TACGTCCTCT
6361 CAACCATCTG TGATCAAATG ACTGGCATAC TAGCGACCGA CGTCACACCG GAGGACGCAC
6421 AGAAGTTGTT AGTGGGATTG AATCAGAGGA TAGTTGTGAA CGGAAGAACA CAGCGAAACA
6481 CTAACACGAT GAAGAACTAT CTGCTTCCGA TTGTGGCCGT CGCATTTAGC AAGTGGSCGA
6541 GGAATACAA GGCAGACCTT GATGATGAAA AACCTCTGGG TGTCCGAGAG AGGTCACTTA
6601 CTTGCTGCTG CTTGTGGGCA TTTAAACGA GGAAGATGCA CACCATGTAC AAGAAACCAAG
6661 ACACCCAGAC AATAGTGAAG GTGCCCTCAG AGTTTAACTC GTTCGTCATC CCGAGCCTAT
6721 GGTCTACAGG CCTCGCAATC CCAGTCAGAT CACGCATTAA GATGCTTTTG GCCAAGAAGA
6781 CCAAGCGAGA GTTAATACCT GTTCTCGACG CGTCGTCAGC CAGGGATGCT GAACAAGAGG
6841 AGAAGGAGAG GTTGGAGGCC GAGCTGACTA GAGAAGCCTT ACCACCCCTC GTCCCCATCG
6901 CGCCGGCGGA GACGGGAGTC GTCGACGTCG ACGTTGAAGA ACTAGAGTAT CACGCAAGTG
6961 CAGGGGTCGT GGAACACCT CGCAGCGCGT TGAAGTCAC CGCACAGCCG AACGACGTAC
7021 TACTAGGAAA TTACGTAGTT CTGTCCCCG AGACCGTGCT CAAGAGCTCC AAGTTGGCCC
7081 CCGTGACACC TCTAGCAGAG CAGGTGAAAA TAATAACACA TAACGGGAGG GCCCGGCGTT
7141 ACCAGGTGCA CGGATATGAC GGCAGGGTCC TACTACCATG TGGATCGGCC ATTCCGCTCC
7201 CTGAGTTTCA GGCTTTGAGC GAGAGCGCCA CTATGGTGTA CAACGAAAGG GAGTTCGTCA
7261 ACAGGAAACT ATACCATATT GCCGTTACG GACCCCTCGT GAACACCGAC GAGGAGAACT
7321 ACGAGAAAGT CAGAGCTGAA AGAACTGACG CCGAGTACGT GTTCGACGTA GATAAAAAAT
7381 GCTGCGTCAA GAGAGAGGAA GCGTCGGGTT TGGTGTGGT GGGAGAGCTA ACCAACCCCC
7441 CGTTCCATGA ATTCGCCTAC GAAGGGCTGA AGATCAGGCC GTCGGCACCA TATAAGACTA
7501 CAGTAGTAGG AGTCTTTGGG GTTCCGGGAT CAGGCAAGTC TGCTATTATT AAGAGCCTCG
7561 TGACCAAACA CGATCTGGTC ACCAGCGGCA AGAAGGAGAA CTGCCAGGAA ATAGTTAACG
7621 ACGTGAAGAA GCACCGCGGG AAGGGGACAA GTAGGGAAAA CAGTGACTCC ATCCTGCTAA
7681 ACGGGTGTGCG TCGTGCCGTG GACATCCTAT ATGTGGACGA GGCTTTGCGT TGCCATTCCG
7741 GTACTCTGCT GGCCCTAATT GCTCTTGTTA AACCTCGGAG CAAAGTGGTG TTATGCGAG
7801 ACCCCAAGCA ATGCGGATTC TTCAATATGA TGCAGCTTAA GGTGAACCTC AACCACAACA
7861 TCTGCACTGA AGTATGTCAT AAAAGTATAT CCAGACGTTG CACGCGTCCA GTCACGSCCA
7921 TCGTGTCTAC GTTGCACTAC GGAGGCAAGA TCGCACGAC CAACCCGTGC AACAAACCCA
7981 TAATCATAGA CACCACAGGA CAGACCAAGC CCAAGCCAGG AGACATCGTG TTAACATGCT
8041 TCCGAGGCTG GGCAAAGCAG CTGCAGTTGG ACTACCGTGG ACACGAAGTC ATGACAGCAG
8101 CAGCATCTCA GGGCCTCACC CGCAAAGGGG TATACGCCGT AAGGCAGAAG GTGAATGAAA
8161 ATCCCTTGTA TGCCCTTCGC TCGGAGCAGC TGAATGTACT GCTGACGCGC ACTGAGGATA
8221 GGCTGGTGTG GAAAACGCTG GCCGCGGATC CCTGGATTAA GGTCTATCA AACATTCCAC
8281 AGGGTAACTT TACGGCCACA TTGGAAGAAT GGCAAGAAGA ACACGACAAA ATAATTGAAG
8341 TGATTGAAGG ACCGGCTGCG CCTGTGGACG CGTTCAGAA CAAAGCGAAC GTGTGTTGGG
8401 CGAAAAGCCT GGTGCCTGTC CTGGACACTG CCGGAATCAG ATTGACAGCA GAGGAGTGGA
8461 GCACCATAAT TACAGCATTT AAGGAGGACA GAGCTTACTC TCCAGTGGTG GCCTTGAATG
8521 AAATTTGCAC CAAGTACTAT GGAGTTGACC TGGACAGTGG CCTGTTTTCT GCCCCGAAGG
8581 TGTCCCTGTA TTACGAGAAC AACCCTGCGG ATAACAGACC TGGTGAAGG ATGTATGAT
8641 TCAATGCCCG AACAGCTGCC AGGCTGGAAG CTAGACATAC CTTCTGAAG GGGCAGTGGC
8701 ATACGGGCAA GCAGGCAGTT ATCGCAGAAA GAAAAATCCA ACCGCTTTCT GTGCTGACAA
8761 ATGTAATTCC TATCAACCGC AGGCTGCCGC ACGCCCTGGT GGCTGAGTAC AAGACGTTA
8821 AAGGCAGTAG GGTGAGTGG CTGGTCAATA AAGTAAGAGG GTACCACGTC CTGATGTTGA
8881 GTGAGTACAA CCTGGCTTTG CCTCGACGCA GGGTCACTTG GTTGTACCG CTGAATGTCA
8941 CAGGCGCCGA TAGGTGCTAC GACCTAAGTT TAGGACTGCC GGCTGACGCC GGCAGGTTCC
9001 ACTTGGTCTT TGTGAACATT CACACGGAAT TCAGAATCCA CCACTACCAG CAGTGTGTCG
9061 ACCACGCCAT GAAGCTGCAG ATGCTTGGGG GAGATGCGCT ACGACTGCTA AAACCCGGCG
9121 GCATCTTGAT GAGAGCTTAC GGATACGCCG ATAAAATCAG CGAAGCCGTT GTTCTCTCCT
9181 TAAGCAGAAA GTTCTCGTCT GCAAGAGTGT TGCGCCCGGA TTGTGTACCC AGCAATACAG
9241 AAGTGTCTCT GCTGTTCTCC AACTTTGACA ACGGAAAGAG ACCCTCTACG CTACACAGAA
9301 TGAATACCAA GCTGAGTGCC GTGTATGCCG GAGAAGCCAT GCACACGGCC GGGTGTGCAC
9361 CATCCTACAG AGTTAAGAGA GCAGACATAG CCACGTGCAC AGAAGCGGCT GTGGTTAACG

FIGURE 29A

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9421 CAGCTAACGC CCGTGGAAC GTAGGGGATG GCGTATGCAG GGCCGTGGCG AAGAAATGGC
9481 CGTCAGCCTT TAAGGGAGCA GCAACACCAG TGGGCACAAT TAAAACAGTC ATGTGCGGCT
9541 CGTACCCCGT CATCCACGCT GTAGCGCCTA ATTTCTCTGC CACGACTGAA GCGGAAGGGG
9601 ACCGCGAATT GGCCGCTGTC TACCGGGCAG TGGCCGCCGA AGTAAACAGA CTGTCACTGA
9661 GCAGCGTAGC CATCCCCGCTG CTGTCCACAG GAGTGTTCAG CGGCGGAAGA GATAGGCTGC
9721 AGCAATCCCT CAACCATCTA TTCACAGCAA TGGACGCCAC GGACGCTGAC GTGACCATCT
9781 ACTGCAGAGA CAAAAGTTGG GAGAAGAAAA TCCAGGAAGC CATTGACATG AGGACGGCTG
9841 TGGAGTTGCT CAATGATGAC GTGGAGCTGA CCACAGACTT GGTGAGAGTG CACCCGGACA
9901 GCAGCCTGGT GGGTCGTAAG GGCTACAGTA CCACTGACGG GTCGCTGTAC TCGTACTTTG
9961 AAGGTACGAA ATTCAACCAG GCTGCTATTG ATATGGCAGA GATACTGACG TTGTGGCCCA
10021 GACTGCAAGA GGCAAACGAA CAGATATGCC TATACGCGCT GGGCGAAACA ATGGACAACA
10081 TCAGATCCAA ATGTCCGGTG AACGATTCCG ATTCATCAAC ACCTCCGAGG ACAGTGCCCT
10141 GCCTGTGCCG CTACGCAATG ACAGCAGAAC GGATCGCCCG CCTTAGGTCA CACCAAGTTA
10201 AAAGCATGGT GGTGTTGCTCA TCTTTTCCCC TCCCGAAATA CCATGTAGAT GGGGTGCAGA
10261 AGGTAAAGTG CGAGAAGGTT CTCCTGTTCTG ACCCGACGGT ACCTTCAGTG GTTAGTCCGC
10321 GGAAGTATGC CGCATCTACG ACGGACCACT CAGATCGGTC GTTACGAGGG TTTGACTTGG
10381 ACTGGACCAC CGACTCGTCT TCCACTGCCA GCGATACCAT GTCGCTACCC AGTTTGCAGT
10441 CGTGTGACAT CGACTCGATC TACGAGCCAA TGGCTCCCAT AGTAGTGACG GCTGACGTAC
10501 ACCCTGAACC CGCAGGCATC CGGCAGATGT GCACCCTGAA CCCGCAGACC
10561 ATGTGGACCT GGAGAACCCG ATTCCTCCAC CGCGCCCGAA GAGAGCTGCA TACCTTGCCT
10621 CCCGCGCGGC GGAGCGACCG GTGCCGCGC CGAGAAAGCC GACGCCTGCC CCAAGGACTG
10681 CGTTTAGGAA CAAGCTGCCT TTGACGTTCTG GCGACTTTGA CGAGCACGAG GTCGATGCGT
10741 TGGCTCCGG GATTACTTTC GGAGACTTCG ACGACGTCCT GCGACTAGGC CGCGCGGGTG
10801 CATATATTTT CTCCTCGGAC ACTGGCAGCG GACATTTACA AAAAAATCC GTTAGGCAGC
10861 ACAATCTCCA GTGCGCACA CTGGATGCGG TCCAGGAGGA GAAAATGTAC CCGCCAAAAT
10921 TGGATACTGA GAGGGAGAAG CTGTTGCTGC TGAATGCA GATGCACCCA TCGGAGGCTA
10981 ATAAGAGTCG ATACCAGTCT CGCAAAGTGG AGAACATGAA AGCCACGGTG GTGGACAGGC
11041 TCACATCGGG GGCCAGATTG TACACGGGAG CGGACGTAGG CCGCATACCA ACATACCGG
11101 TTCGTACCC CCGCCCCGTG TACTCCCTTA CCGTGATCGA AAGATTCTCA AGCCCCGATG
11161 TAGCAATCGC AGCGTGCAAC GAATACCTAT CCAGAAATTA CCCAACAGTG GCGTCGTACC
11221 AGATAACAGA TGAATACGAC GCATACTTGG ACATGGTTGA CGGGTCGGAT AGTTGCTTGG
11281 ACAGAGCGAC ATTCTGCCCC GCGAAGCTCC GGTGCTACCC GAAACATCAT GCGTACCACC
11341 AGCCGACTGT ACGCAGTGCC GTCCCGTCAC CCTTTCAGAA CACACTACAG AACGTGCTAG
11401 CGGCTGCCAC CAAGAGAAAC TGCAACGTCA CGCAAATGCG AGAACTACCC ACCATGGACT
11461 CGGCAGTGTT CAACGTGGAG TGCTTCAAGC GCTATGCCTG CTCCGGAGAA TATTGGGAAG
11521 AATATGCTAA ACAACCTATC CGGATAACCA CTGAGAACAT CACTACCTAT GTGACCAAAT
11581 TGAAAGGCCC GAAAGCTGCT GCCTTGTTCTG CTAAGACCCA CAACTTGGTT CCGCTGCAGG
11641 AGGTTCCCAT GGACAGATTG ACGGTCGACA TGAAACGAGA TGTCAAAGTC ACTCCAGGGA
11701 CGAAACACAC AGAGGAAAGA CCCAAAGTCC AGGTAATTCA AGCAGCGGAG CCATTGGCGA
11761 CCGCTTACCT GTGCGGCATC CACAGGGAAT TAGTAAGGAG ACTAAATGCT GTGTTACGCC
11821 CTAACGTGCA CACATTGTTT GATATGTCGG CCGAAGACTT TGACGCGATC ATCGCCTCTC
11881 ACTTCCACCC AGGAGACCCG GTTCTAGAGA CGGACATTGC ATCATTCGAC AAAAGCCAGG
11941 ACGACTCCTT GGCTCTTACA GGTTAATGA TCCTCGAAGA TCTAGGGGTG GATCAGTACC
12001 TGCTGGACTT GATCGAGGCA GCCTTTGGGG AAATATCCAG CTGTCACCTA CCAACTGGCA
12061 CGCGCTTCAA GTTCGGAGCT ATGATGAAAT CGGGCATGTT TCTGACTTTG TTTATTAACA
12121 CTGTTTTGAA CATCACCATA GCAAGCAGGG TACTGGAGCA GAGACTCACT GACTCCGCCT
12181 GTGCGGCCCTT CATCGGCGAC GACAACATCG TTCACGGAGT GATCTCCGAC AAGCTGATGG
12241 CGGAGAGGTG CGCGTCGTGG GTCAACATGG AGGTGAAGAT CATTGACGCT GTCATGGGCG
12301 AAAAAACCCC ATATTTTTGT GGGGGATTCA TAGTTTTTGA CAGCGTCACA CAGACCCCT
12361 GCCGTGTTTC AGACCACTT AAGCGCCTGT TCAAGTTGGG TAAGCCGCTA ACAGCTGAAG
12421 ACAAGCAGGA CGAAGACAGG CGACGAGCAC TGAGTGACGA GGT

FIGURE 29E

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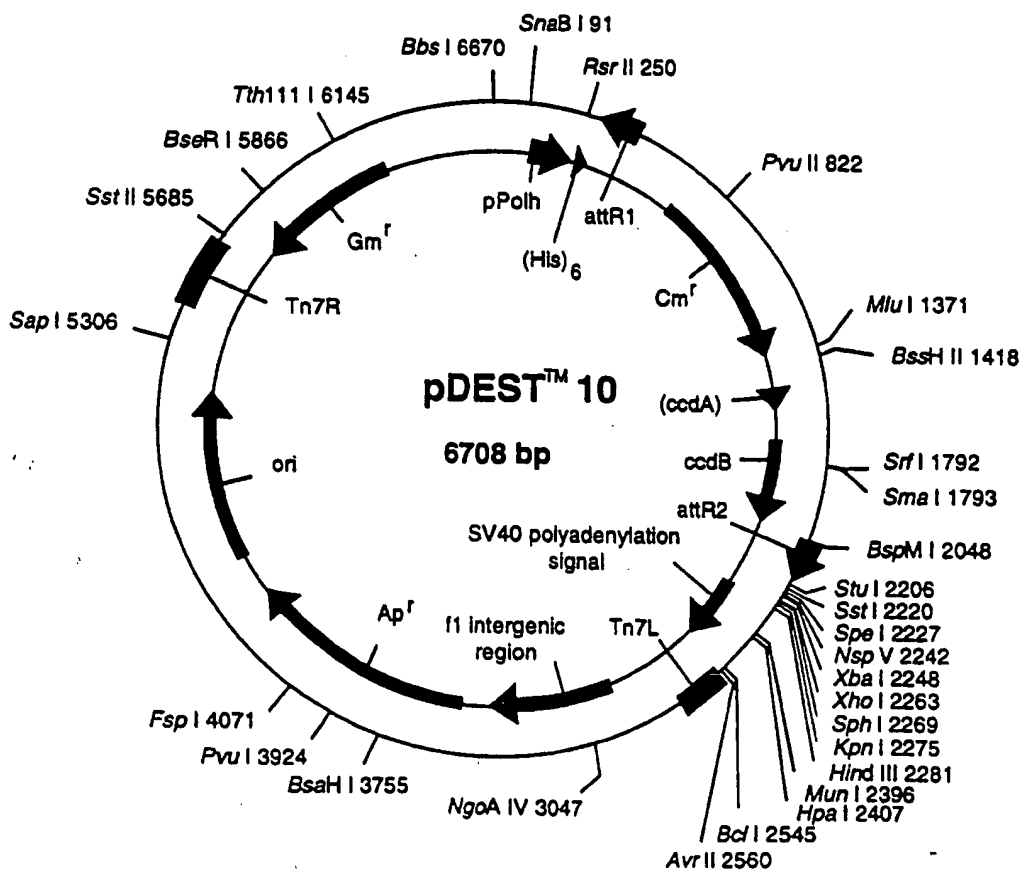
**Figure 30A: pDEST10 Polyhedron Promoter with N-His₆,
Baculovirus Transfer Plasmid**

154 *→ mRst from polyhedrin promoter*
 aaa taa gta ttt tac tgt ttt cgt aac agt ttt gta ata aaa aaa cct ata
 ttt att cat aaa atg aca aaa gca ttg tca aaa cat tat ttt ttt gga tat

205
 aat att ccg gat tat tca tac cgt ccc acc atc ggg cgc gga tet cgg tcc
 tta taa ggc cta ata agt atg gca ggg tgg tag ccc gcg cct aga gcc agg

256 Met Ser Tyr Tyr His His His His His His Asp Tyr Asp Ile Pro
 gaa acc atg tgg tac tac tac cat cac cat cac cat cac gat tac gat atc cca
 ctt tgg tac agc atg atg gta gtg gta gtg gta gtg cta atg cta tag ggt

307 TEV protease
 Thr Thr Glu Asn Leu Tyr Phe Gln Gly Ile Thr Ser Leu Tyr Lys Lys
 acg acc gaa aac ctg tat ttt cag ggc atc aca agt tgg tac aac aac ggc
 tgc tgg ctt ttg gac ata aaa gtc ccg tag tgt tca aac atg ttt ttt cga
 attR1 Int



pDEST10 6708 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
23..152		Ppolh
461..337		attR1
711..1370		CmR
1490..1574		inactivated ccdA
1712..2017		ccdB
2058..2182		attR2
3394..4369		ampR
4510..5164		ori
5658..62		genR

1	CCCCGGATGA	AGTGGTTCGC	ATCCTCGGTT	TTCTGGAAGG	CGAGCATCGT	TTGTTCGCCC
61	AGGACTCTAG	CTATAGTTCT	AGTGGTTGGC	TACGTATACT	CCGGAATATT	AATAGATCAT
121	GGAGATAATT	AAAATGATAA	CCATCTCGCA	AATAAATAAG	TATTTTACTG	TTTTCGTAAC
181	AGTTTTGTAA	TAAAAAAACC	TATAAATATT	CCGGATTATT	CATACCGTCC	CACCATCGGG
241	CGCGGATCTC	GGTCCGAAAC	CATGTCGTAC	TACCATCACC	ATCACCATCA	CGATTACGAT
301	ATCCCAACGA	CCGAAAACCT	GTATTTTCAG	GGCATCACAA	GTTTGTACAA	AAAAGCTGAA
361	CGAGAAACGT	AAAATGATAT	AAATATCAAT	ATATTAAATT	AGATTTTGCA	TAAAAAACAG
421	ACTACATAAT	ACTGTAAAAC	ACAACATATC	CAGTCACTAT	GGCGGCCGCT	AAGTTGGCAG
481	CATCACCCGA	CGCACTTTGC	GCCGAATAAA	TACCTGTGAC	GGAAGATCAC	TTGCGAGAAT
541	AAATAAATCC	TGGTGTCCCT	GTTGATACCG	GGAAGCCCTG	GGCCAACTTT	TGGCGAAAAT
601	GAGACGTTGA	TCGGCACGTA	AGAGGTTCCA	ACTTTCACCA	TAATGAAATA	AGATCACTAC
661	CGGGCGTATT	TTTTGAGTTA	TCGAGATTTT	CAGGAGCTAA	GGAAGCTAAA	ATGGAGAAAA
721	AAATCACTGG	ATATAACCAC	GTTGATATAT	CCCAATGGCA	TCGTAAAGAA	CATTTTGAGG
781	CATTTTCAGTC	AGTTGCTCAA	TGTACCTATA	ACCAGACCGT	TCAGCTGGAT	ATTACGGCCT
841	TTTTAAAGAC	CGTAAAGAAA	AATAAGCACA	AGTTTTATCC	GGCCTTTATT	CACATTCTTG
901	CCGCGCTGAT	GAATGCTCAT	CCGGAATTCC	GTATGGCAAT	GAAAGACGGT	GAGCTGGTGA
961	TATGGGATAG	TGTTACCCCT	TGTTACACCG	TTTTCCATGA	GCAAAC TGAA	ACGTTTTTCAT
1021	CGCTCTGGAG	TGAATACCAC	GACGATTTCC	GGCAGTTTCT	ACACATATAT	TCGCAAGATG
1081	TGGCGTGTTA	CGGTGAAAAC	CTGGCCTATT	TCCCTAAAGG	GTTTATTGAG	AATATGTTTT
1141	TCGTCTCAGC	CAATCCCTGG	GTGAGTTTCA	CCAGTTTTGA	TTTAAACGTG	GCCAATATGG
1201	ACAAC TTCTT	CGCCCCCGTT	TTCACCATGG	GCAAATATTA	TACGCAAGGC	GACAAGGTGC
1261	TGATGCCGCT	GGCGATT CAG	GTT CATCATG	CCGTCTGTGA	TGGCTTCCAT	GTCGGCAGAA
1321	TGCTTAATGA	ATTACAACAG	TACTGCGATG	AGTGGCAGGG	CGGGGCGTAA	ACGCGTGGAT
1381	CCGGCTTACT	AAAAGCCAGA	TAACAGTATG	CGTATTTGCG	CGCTGATTTT	TGCGGTATAA
1441	GAATATATAC	TGATATGTAT	ACCCGAAGTA	TGTCAAAAAG	AGGTGTGCTA	TGAAGCAGCG
1501	TATTACAGTG	ACAGTTGACA	GCGACAGCTA	TCAGTTGCTC	AAGGCATATA	TGATGTCAAT
1561	ATCTCCGGTC	TGGTAAGCAC	AACCATGCAG	AATGAAGCCC	GTCGTCTGCG	TGCCGAACGC
1621	TGGAAAGCGG	AAAATCAGGA	AGGGATGGCT	GAGGTCGCCC	GGTTTATTGA	AATGAACGGC
1681	TCTTTTGCTG	ACGAGAACAG	GGACTGGTGA	AATGCAGTTT	AAGGTTTACA	CCTATAAAAG
1741	AGAGAGCCGT	TATCGTCTGT	TTGTGGATGT	ACAGAGTGAT	ATTATTGACA	CGCCCGGGCG
1801	ACGGATGGTG	ATCCCCCTGG	CCAGTGACAG	TCTGCTGTCA	GATAAAGTCT	CCCGTGAACT
1861	TTACCCGGTG	GTGCATATCG	GGGATGAAAG	CTGGCGCATG	ATGACCACCG	ATATGGCCAG
1921	TGTGCCGGTC	TCCGTTATCG	GGGAAGAAGT	GGCTGATCTC	AGCCACCGCG	AAAATGACAT
1981	CAAAAACGCC	ATTAACCTGA	TGTTCTGGGG	AATATAAATG	TCAGGCTCCC	TTATACACAG
2041	CCAGTCTGCA	GGTCGACCAT	AGTGACTGGA	TATGTTGTGT	TTTACAGTAT	TATGTAGTCT
2101	GTTTTTTATG	CAAAATCTAA	TTTAATATAT	TGATATTTAT	ATCATTTTAC	GTTTCTCGTT
2161	CAGCTTTCTT	GTACAAAGTG	GTGATGCCAT	GGATCCGGAA	TTCAAAGGCC	TACGTCGACG
2221	AGCTCAACTA	GTGCGGCCGC	TTTCGAATCT	AGAGCCTGCA	GTCTCGAGGC	ATGCGGTACC
2281	AAGCTTGTCTG	AGAAGTACTA	GAGGATCATA	ATCAGCCATA	CCACATTTGT	AGAGGTTTTA
2341	CTTGCTTTAA	AAAACCTCCC	ACACCTCCCC	CTGAACCTGA	AACATAAAAT	GAATGCAATT
2401	GTTGTTGTTA	ACTTGTTTAT	TGCAGCTTAT	AATGGTTACA	AATAAAGCAA	TAGCATCACA
2461	AATTTACAAA	ATAAAGCATT	TTTTTCACTG	CATTCTAGTT	GTGGTTTGTC	CAAAC TCATC
2521	AATGTATCTT	ATCATGTCTG	GATCTGATCA	CTGCTTGAGC	CTAGGAGATC	CGAACCAGAT
2581	AAGTGAAATC	TAGTTCCAAA	CTATTTTGTC	ATTTTTAATT	TTCGTATTAG	CTTACGACGC-

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2641 TACACCCAGT TCCCATCTAT TTTGTCACTC TTCCCTAAAT AATCCTTAAA AACTCCATTT
 2701 CCACCCCTCC CAGTTCCCAA CTATTTTGTG CGCCACAGC GGGGCATTTT TCTTCCTGTT
 2761 ATGTTTTTAA TCAAACATCC TGCCAACTCC ATGTGACAAA CCGTCATCTT CGGCTACTTT
 2821 TTCTCTGTCA CAGAATGAAA ATTTTCTGT CATCTCTTCG TTATTAATGT TTGTAATTGA
 2881 CTGAATATCA ACGCTTATTT GCAGCCTGAA TGGCGAATGG GACGCGCCCT GTAGCGGCGC
 2941 ATTAAGCGCG GCGGGTGTGG TGGTTACGCG CAGCGTGACC GCTACACTTG CCAGCGCCCT
 3001 AGCGCCCGCT CCTTTCGCTT TCTTCCCTTC CTTTCTCGCC ACGTTCGCCG GCTTTCCTCG
 3061 TCAAGCTCTA AATCGGGGGC TCCCTTTAGG GTTCCGATTT AGTGCTTTAC GGCACCTCGA
 3121 CCCCCAAAAA CTTGATTAGG GTGATGGTTC ACGTAGTGGG CCATCGCCCT GATAGACGGT
 3181 TTTTCGCCCT TTGACGTTGG AGTCCACGTT CTTTAATAGT GGA CTCTTGT TCCAACTGG
 3241 AACCAACTC AACCCTATCT CGGTCTATT TTTTGATTTA TAAGGGATT TGCCGATTTC
 3301 GGCCTATTGG TTAAAAATG AGCTGATTTA ACAAAAAATT AACGCGAATT TTAACAAAAT
 3361 ATTAACGTTT ACAATTTTCA GTGGCACTTT TCGGGGAAAT GTGCGCGGAA CCCCTATTTG
 3421 TTTATTTTTT TAAATACATT CAAATATGTA TCCGCTCATG AGACAATAAC CCTGATAAAT
 3481 GCTTCAATAA TATTGAAAAA GGAAGAGTAT GAGTATTCAA CATTTCCGTG TCGCCCTTAT
 3541 TCCCTTTTTT GCGGCATTTT GCCTTCCTGT TTTTGCTCAC CCAGAAACGC TGGTGAAAGT
 3601 AAAAGATGCT GAAGATCAGT TGGGTGCACG AGTGGGTAC ATCGAACTGG ATCTCAACAG
 3661 CGGTAAGATC CTTGAGAGTT TTCGCCCCGA AGAACGTTTT CCAATGATGA GCACTTTTAA
 3721 AGTTCTGCTA TGTGGCGCGG TATTATCCCG TATTGACGCC GGGCAAGAGC AACTCGGTGCG
 3781 CCGCATACAC TATTCTCAGA ATGACTTGGT TGAGTACTCA CCAGTCACAG AAAAGCATCT
 3841 TACGGATGGC ATGACAGTAA GAGAATTATG CAGTGCTGCC ATAACCATGA GTGATAACAC
 3901 TGCGGCCAAC TTACTTCTGA CAACGATCGG AGGACCGAAG GAGCTAACCG CTTTTTTGCA
 3961 CAACATGGGG GATCATGTAA CTCGCTTGA TCGTTGGGAA CCGGAGCTGA ATGAAGCCAT
 4021 ACCAAACGAC GAGCGTGACA CCACGATGCC TGTAGCAATG GCAACAACGT TGCGCAAACT
 4081 ATTAAGTGGC GAACTACTTA CTCTAGCTTC CCGGCAACAA TTAATAGACT GGATGGAGGC
 4141 GGATAAAGTT GCAGGACCAC TTCTGCGCTC GGCCTTCCG GCTGGCTGGT TTATTGCTGA
 4201 TAAATCTGGA GCCGGTGAGC GTGGGTCTCG CGGTATCATT GCAGCACTGG GGCCAGATGG
 4261 TAAGCCCTCC CGTATCGTAG TTATCTACAC GACGGGGAGT CAGGCAACTA TGGATGAACG
 4321 AAATAGACAG ATCGCTGAGA TAGGTGCCTC ACTGATTAAG CATTGGTAAC TGTCAGACCA
 4381 AGTTTACTCA TATATACTTT AGATTGATTT AAAACTTCAT TTTTAATTTA AAAGGATCTA
 4441 GGTGAAGATC CTTTTTGATA ATCTCATGAC CAAAATCCCT TAACGTGAGT TTTCTGTCCA
 4501 CTGAGCGTCA GACCCCGTAG AAAAGATCAA AGGATCTTCT TGAGATCCTT TTTTCTGCG
 4561 CGTAATCTGC TGCTTGCAAA CAAAAAACC ACCGCTACCA GCGGTGGTTT GTTTGCCGGA
 4621 TCAAGAGCTA CCAACTCTTT TTCCGAAGGT AACTGGCTTC AGCAGAGCGC AGATACCAAA
 4681 TACTGTCTTT CTAGTGTAGC CGTAGTTAGG CCACCACTTC AAGAACTCTG TAGCACC GCC
 4741 TACATACCTC GCTCTGCTAA TCCTGTTACC AGTGGCTGCT GCCAGTGGCG ATAAGTCTGT
 4801 TCTTACCGGG TTGGACTCAA GACGATAGTT ACCGGATAAG GCGCAGCGGT CGGGCTGAAC
 4861 GGGGGGTTCTG TGCACACAGC CCAGCTTGGA GCGAACGACC TACACCGAAC TGAGATACCT
 4921 ACAGCGTGAG CATTGAGAAA GCGCCACGCT TCCCGAAGGG AGAAAGGCGG ACAGGTATCC
 4981 GGTAAAGCGG AGGGTCGGAA CAGGAGAGCG CACGAGGGAG CTTCCAGGGG GAAACGCCTG
 5041 GTATCTTTAT AGTCTGTGCG GGTTCGCCA CCTCTGACTT GAGCGTCGAT TTTTGTGATG
 5101 CTCGTACAGG GGGCGGAGCC TATGGAAAAA CGCCAGCAAC GCGGCCTTTT TACGGTTCTT
 5161 GGCCTTTTGC TGGCCTTTTG CTCACATGTT CTTTCTGCG TTATCCCTG ATTCTGTGGA
 5221 TAACCGTATT ACCGCCTTTG AGTGAGCTGA TACCGCTCGC CGCAGCCGAA CGACCGAGCG
 5281 CAGCGAGTCA GTGAGCGAGG AAGCGGAAGA GCGCCTGATG CGGTATTTT TCCTTACGCA
 5341 TCTGTGCGGT ATTTACACAC GCAGACCAGC CGCGTAACCT GGCAAAATCG GTTACGGTTG
 5401 AGTAATAAAT GGATGCCCTG CGTAAGCGGG TGTGGGCGGA CAATAAAGTC TTAAGTGA
 5461 CAAAATAGAT CTAAGTATG ACAATAAAGT CTTAACTAG ACAGAATAGT TGTAACTGA
 5521 AATCAGTCCA GTTATGCTGT GAAAAAGCAT ACTGGACTTT TGTATGGCT AAAGCAAAC
 5581 CTTCAATTTT TGAAGTGCAA ATTGCCGCTC GTATTAAAGA GGGGCGTGGC CAAGGGCATG
 5641 GTAAAGACTA TATTCGCGGC GTTGAGCAA TTTACCGAAC AACTCCGCGG CCGGGAAGCC
 5701 GATCTCGGCT TGAACGAATT GTTAGTGAG AGCCACTGCG GGATCGTCAC CGTAATCTGC
 5761 TTCTTCCCGT ATGCCCAACT TTGTATAGAG AGCCACTGCG GGATCGTCAC CGTAATCTGC
 5821 TTGCACGTAG ATCACATAAG CACCAAGCGC GTTGGCCTCA TGCTTGAGGA GATTGATGAG
 5881 CGCGGTGGCA ATGCCCTGCC TCCGGTGCTC GCCGGAGACT GCGAGATCAT AGATATAGAT
 5941 CTCACACGCG GGCTGCTCAA ACCTGGGCAG AACGTAAGCC GCGAGAGCGC CAACAACCGC
 6001 TTCTTGGTGC AAGGCAGCAA GCGCGATGAA TGTCTTACTA CGGAGCAAGT TCCCGAGGTA
 6061 ATCGGAGTCC GGCTGATGTT GGGAGTAGGT GGCTACGTCT CCGAACTCAC GACCGAAAAG-

FIGURE 30C

6121 ATCAAGAGCA GCCCGCATGG ATTTGACTTG GTCAGGGCCG AGCCTACATG TCGGAATGAT
6181 GCCCATACTT GAGCCACCTA ACTTTGTTTT AGGGCGACTG CCCTGCTGCG TAACATCGTT
6241 GCTGCTGCGT AACATCGTTG CTGCTCCATA ACATCAAACA TCGACCCACG GCGTAACGCG
6301 CTTGCTGCTT GGATGCCCCG GGCATAGACT GTACAAAAAA ACAGTCATAA CAAGCCATGA
6361 AAACCGCCAC TGCGCCGTTA CCACCGCTGC GTTCGGTCAA GGTTCCTGGAC CAGTTGCGTG
6421 AGCGCATACG CTA CTGTCAT TACAGTTTAC GAACCGAACA GGCTTATGTC AACTGGGTTC
6481 GTGCCTTCAT CCGTTTCCAC GGTGTGCGTC ACCCGGCAAC CTTGGGCAGC AGCGAAGTCG
6541 AGGCATTTCT GTCCTGGCTG GCGAACGAGC GCAAGGTTTC GGTCTCCACG CATCGTCAGG
6601 CATTGGCGGC CTTGCTGTTC TTCTACGGCA AGGTGCTGTG CACGGATCTG CCCTGGCTTC
6661 AGGAGATCGG AAGACCTCGG CCGTCGCGGC GCTTGCCGGT GGTGCTGA

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Figure 31A:

p DEST 11

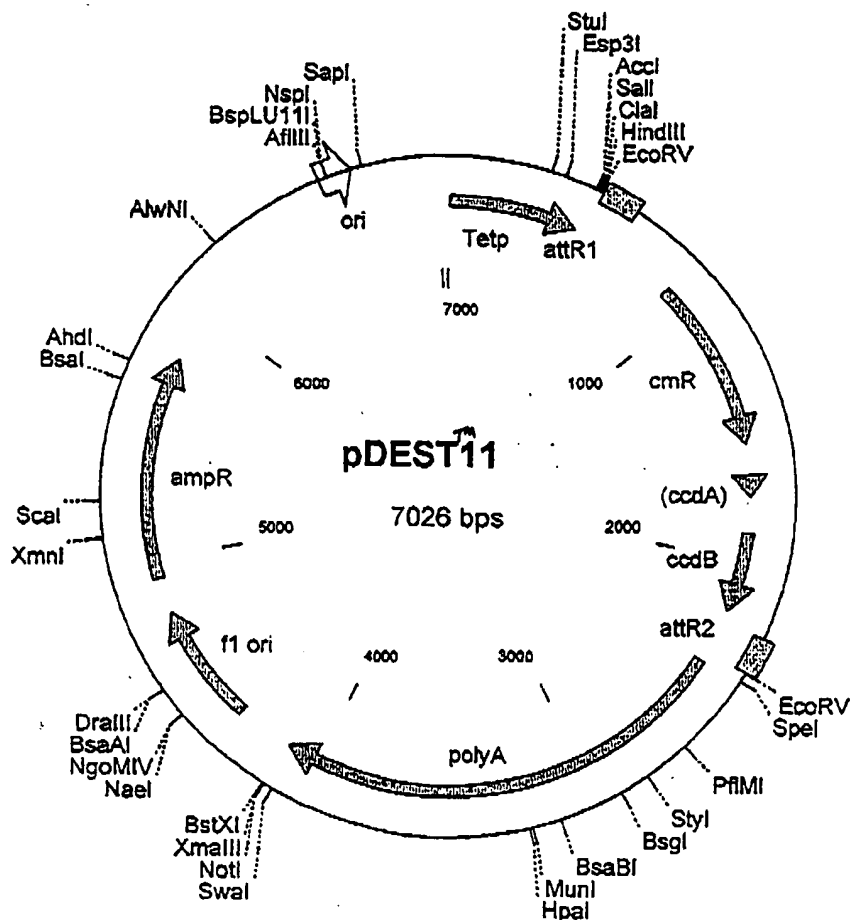
Tet-regulated eukaryotic expression

358 tag tga acc gfc aga tgc cct gga gac gcc atc cac gct gtt tgg acc tcc
atc act tgg cag tct agc gga cct ctg cgg tag gtg cga caa aac tgg agg

409 ata gaa gac acc ggg acc gat cca gcc tcc gcg gcc ccg aat tcg agc tgc
tat ctt ctg tgg ccc tgg cta ggt cgg agg cgc cgg ggc tta agc tgc agc

460 gta ccc ggg gat cct cta gag tgc agg tgc acg gta tgc ata agc ttg aga
cat ggg ccc cta gga gat ctc agc tcc agc tgc cat agc tat tgc acc tat

511 tca aca agt tgc tag aac aag gct gaa cga gaa acg taa atg gat ata gat
agt tgt tca aac atg ttt ttc cga ctt gct ctt tgc att tta cta cat tta



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pDEST11 7026 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
4..479		Tetp ((Tet operator)7 and min hCMV promoter)
638..514		attR1
888..1547		CmR
1667..1751		inactivated ccdA
1889..2194		ccdB
2235..2359		attR2
2402..4132		polyA
4347..4803		f1 ori
4940..5797		ampR

1	CGAGTTTACC	ACTCCCTATC	AGTGATAGAG	AAAAGTGAAA	GTCGAGTTTA	CCACTCCCTA
61	TCAGTGATAG	AGAAAAGTGA	AAGTCGAGTT	TACCACTCCC	TATCAGTGAT	AGAGAAAAGT
121	GAAAGTCGAG	TTTACCACTC	CCTATCAGTG	ATAGAGAAAA	GTGAAAGTCG	AGTTTACCAC
181	TCCCTATCAG	TGATAGAGAA	AAGTGAAAGT	CGAGTTTACC	ACTCCCTATC	AGTGATAGAG
241	AAAAGTGAAA	GTCGAGTTTA	CCACTCCCTA	TCAGTGATAG	AGAAAAGTGA	AAGTCGAGCT
301	CGGTACCCGG	GTCGAGTAGG	CGGTACGGT	GGGAGGCCTA	TATAAGCAGA	GCTCGTTTAG
361	TGAACCGTCA	GATCGCCTGG	AGACGCCATC	CACGCTGTTT	TGACCTCCAT	AGAAGACACC
421	GGGACCGATC	CAGCCTCCGC	GGCCCCGAAT	TCGAGCTCGG	TACCCGGGGA	TCCTCTAGAG
481	TCGAGGTCGA	CGGTATCGAT	AAGCTTGATA	TCAACAAGTT	TGTACAAAAA	AGCTGAACGA
541	GAAACGTAAA	ATGATATAAA	TATCAATATA	TTAAATTAGA	TTTTGCATAA	AAAACAGACT
601	ACATAATACT	GTA AACACA	ACATATCCAG	TCACTATGGC	GGCCGCTAAG	TTGGCAGCAT
661	CACCCGACGC	ACTTTGCGCC	GAATAAATAC	CTGTGACGGA	AGATCACTTC	GCAGAATAAA
721	TAAATCCTGG	TGTCCCTGTT	GATACCGGGA	AGCCCTGGGC	CAACTTTTGG	CGAAATGAG
781	ACGTTGATCG	GCACGTAAGA	GGTTCCAAC	TTCACCATAA	TGAAATAAGA	TCACTACCGG
841	GCGTATTTTT	TGAGTTATCG	AGATTTTCAG	GAGCTAAGGA	AGCTAAAATG	GAGAAAAAAA
901	TCACTGGATA	TACCACCGTT	GATATATCCC	AATGGCATCG	TAAAGAACAT	TTTGAGGCAT
961	TTCAAGTCAGT	TGCTCAATGT	ACCTATAACC	AGACCGTTCA	GCTGGATATT	ACGGCCTTTT
1021	TAAAGACCGT	AAAGAAAAAT	AAGCACAAGT	TTTATCCGGC	CTTTATTCAC	ATTCTTGCCC
1081	GCCTGATGAA	TGCTCATCCG	GAATTCGGTA	TGGCAATGAA	AGACGGTGAG	CTGGTGATAT
1141	GGGATAGTGT	TCACCCCTGT	TACACCGTTT	TCCATGAGCA	AACTGAAACG	TTTTCATCGC
1201	TCTGGAGTGA	ATACCACGAC	GATTTCCGGC	AGTTTCTACA	CATATATTCT	CAAGATGTGG
1261	CGTGTTACGG	TGAAAACCTG	GCCTATTTCC	CTAAAGGGTT	TATTGAGAAT	ATGTTTTTCG
1321	TCTCAGCCAA	TCCCTGGGTG	AGTTTCACCA	GTTTTGATTT	AAACGTGGCC	AATATGGACA
1381	ACTTCTTCGC	CCCCGTTTTT	ACCATGGGCA	AATATTATAC	GCAAGGCGAC	AAGGTGCTGA
1441	TGCCGCTGGC	GATTCAGGTT	CATCATGCCG	TCTGTGATGG	CTTCCATGTC	GGCAGAATGC
1501	TTAATGAATT	ACAACAGTAC	TGCGATGAGT	GGCAGGGCGG	GGCGTAAAGA	TCTGGATCCG
1561	GCTTACTAAA	AGCCAGATAA	CAGTATGCGT	ATTTGCGCGC	TGATTTTTCG	GGTATAAGAA
1621	TATATACTGA	TATGTATACC	CGAAGTATGT	CAAAAAGAGG	TGTGCTATGA	AGCAGCGTAT
1681	TACAGTGACA	GTTGACAGCG	ACAGCTATCA	GTTGCTCAAG	GCATATATGA	TGTCAATATC
1741	TCCGGTCTGG	TAAGCACAAC	CATGCAGAAT	GAAGCCCGTC	GTCTGCGTGC	CGAACGCTGG
1801	AAAGCGGAAA	ATCAGGAAGG	GATGGCTGAG	GTCGCCCCGT	TTATTGAAAT	GAACGGCTCT
1861	TTTGCTGACG	AGAACAGGGA	CTGGTGAAAT	GCAGTTTAAG	GTTTACACCT	ATAAAAGAGA
1921	GAGCCGTTAT	CGTCTGTTTG	TGGATGTACA	GAGTGATATT	ATTGACACGC	CCGGGCGACG
1981	GATGGTGATC	CCCCTGGCCA	GTGCACGTCT	GCTGTCAGAT	AAAGTCTCCC	GTGAACTTTA
2041	CCCGGTGGTG	CATATCGGGG	ATGAAAGCTG	GCGCATGATG	ACCACCGATA	TGGCCAGTGT
2101	GCCGGTCTCC	GTTATCGGGG	AAGAAGTGGC	TGATCTCAGC	CACCGCGAAA	ATGACATCAA
2161	AAACGCCATT	AACCTGATGT	TCTGGGGAAT	ATAAATGTCA	GGCTCCCTTA	TACACAGCCA
2221	GTCTGCAGGT	CGACCATAGT	GACTGGATAT	GTTGTGTTTT	ACAGTATTAT	GTAGTCTGTT
2281	TATTTATGCA	AATCTAATTT	AATATATTGA	TATTTATATC	ATTTTACGTT	TCTCGTTTCA
2341	CTTTCTTGTA	CAAAGTGGTT	GATATCGAAT	TCCTGCAGCC	CGGGGGATCC	ACTAGTTCTA
2401	GAGCACTGCG	ATGAGTGGCA	GGGCGGGGCG	TAATTTTTTT	AAGGCAGTTA	TTGGTGCCCT
2461	TAAACGCCTG	GTGCTACGCC	TGAATAAGTG	ATAATAAGCG	GATGAATGGC	AGAAATTCGC
2521	CGGATCTTTG	TGAAGGAACC	TTACTTCTGT	GGTGTGACAT	AATTGGACAA	ACTACCTACA-

FIGURE 31B

2581 GAGATTTAAA GCTCTAAGGT AAATATAAAA TTTTAAAGTG TATAATGTGT TAAACTACTG
2641 ATTCTAATTG TTTGTGTATT TTAGATTCCA ACCTATGGAA CTGATGAATG GGAGCAGTGG
2701 TGGAAATGCCT TTAATGAGGA AAACCTGTTT TGCTCAGAAG AAATGCCATC TAGTGATGAT
2761 GAGGCTACTG CTGACTCTCA ACATTCTACT CCTCCAAAAA AGAAGAGAAA GGTAGAAGAC
2821 CCAAGGACT TTCCTTCAGA ATTGCTAAGT TTTTGTAGTC ATGCTGTGTT TAGTAATAGA
2881 ACTCTTGCTT GCTTTGCTAT TTACACCACA AAGGAAAAAG CTGCACTGCT ATACAAGAAA
2941 ATTATGGAAA AATATTCTGT AACCTTTATA AGTAGGCATA ACAGTTATAA TCATAACATA
3001 CTGTTTTTTC TTAATCCACA CAGGCATAGA GTGTCTGCTA TTAATAACTA TGCTCAAAAA
3061 TTGTGTACCT TTAGCTTTTT AATTGTAAA GGGGTAAATA AGGAATATTT GATGTATAGT
3121 GCCTTGACTA GAGATCATAA TCAGCCATAC CACATTGTGA GAGGTTTTAC TTGCTTTAAA
3181 AACCTCCCA CACCTCCCC TGAACCTGAA ACATAAAATG AATGCAATTG TTGTTGTAA
3241 CTTGTTTATT GCAGCTTATA ATGGTTACAA ATAAAGCAAT AGCATCACA ATTTACAAAA
3301 TAAAGCATTT TTTTCACTGC ATTCTAGTTG TGGTTGTCC AAATCATCA ATGTATCTTA
3361 TCATGTCTGG ATCCCCAGGA AGCTCCTCTG TGTCCTCATA AACCTTAACC TCCTCTACTT
3421 GAGAGGACAT TCCAATCATA GGCTGCCCAT CCACCTCTG TGTCCTCTG TTAATTAGGT
3481 CACTTAACAA AAAGGAAATT GGGTAGGGT TTTTCACAGA CCGCTTCTA AGGGTAATTT
3541 TAAAATATCT GGAAGTCCC TTCACTGCT GTGTCCAGA AGTGTGGTA AACAGCCAC
3601 AAATGTCAAC AGCAGAAACA TACAAGCTGT CAGCTTTGCA CAAGGGCCCA ACACCTGCT
3661 CATCAAGAAG CACTGTGGT GCTGTGTTAG TAATGTGCAA AACAGGAGGC ACATTTTCCC
3721 CACCTGTGTA GGTTCACAAA TATCTAGTGT TTTTCAATTT ACTTGATCA GGAACCCAGC
3781 ACTCCACTGG ATAAGCATT TCTTATCCA AAACAGCCTT GTGGTCAGT TTCATCTGCT
3841 GACTGTCAAC TGTAGCATTT TTTGGGGTTA CAGTTTGAGC AGGATATTTG GTCCTGTAGT
3901 TTGCTAACAC ACCCTGCAGC TCCAAAGGTT CCCCACCAAC AGCAAAAAAA TGAATAATTG
3961 ACCCTTGAAT GGGTTTTCCA GCACCATTTT CATGAGTTT TTGTGTCCCT GAATGCAAGT
4021 TTAACATAGC AGTTACCCCA ATAACCTCAG TTTTAACAGT AACAGCTTCC CACATCAAAA
4081 TATTTCCACA GGTAAAGTCC TCATTTAAAT TAGGCAAAGG AATTGCTCTA GAGCGGCCGC
4141 CACCGCGGTG GAGCTCCAAT TCGCCCTATA GTGAGTCGTA TTACGCGCGC TCACTGGCCG
4201 TCGTTTTACA ACGTCGTGAC TGGGAAAACC CTGGCGTTAC CCAACTTAAT CGCCTTGACG
4261 CACATCCCCC TTTGCCGAGC TGGCGTAATA GCGAAGAGGC CCGCACCGAT CGCCCTTCCC
4321 AACAGTTGCG CAGCCTGAAT GGCGAATGGG ACGCGCCCTG TAGCGGCGCA TTAAGCGCGG
4381 CGGGTGTGGT GGTACGCGC AGCGTGACCG CTACACTTGC CAGCGCCCTA GCGCCCGCTC
4441 CTTTCGCTTT TTTCCCTTCC TTTCTCGCCA CGTTGCGCG CTTTCCCGCT CAAGCTCTAA
4501 ATCGGGGGCT CCCTTTAGGG TTCCGATTTA GTGCTTTACG GCACCTCGAC CCAAAAAAAC
4561 TTGATTAGGG TGATGGTTCA CGTAGTGGG CATCGCCCTG ATAGACGGTT TTTGCGCTT
4621 TGACGTTGGA GTCCACGTT TTTAATAGTG GACTCTTGT CCAAACTGGA ACAACACTCA
4681 ACCCTATCTC GGTCTATTCT TTTGATTTAT AAGGGATTTT GCCGATTTG GCCTATTGGT
4741 TAAAAAATGA GCTGATTTAA CAAAAATTTA ACGCGAATTT TAACAAAATA TTAACGCTTA
4801 CAATTTAGGT GGCACTTTTT GGGGAAATGT GCGCGGAACC CCTATTTGTT TATTTTCTA
4861 AATACATTCA AATATGTATC CGCTCATGAG ACAATAACCC TGATAAATGC TTCAATAATA
4921 TTGAAAAGG AAGAGTATGA GTATTCAACA TTTCCGTGTC GCCCTTATTC CCTTTTTGTC
4981 GGCATTTTGC CTTCTGTGTT TTGCTCACC AGAAACGCTG GTGAAAGTAA AAGATGCTGA
5041 AGATCAGTTG GGTGCACGAG TGGGTTACAT CGAACTGGAT CTCAACAGCG GTAAGATCCT
5101 TGAGAGTTTT CGCCCCGAAG AACGTTTTCC AATGATGAGC ACTTTTAAAG TTCTGCTATG
5161 TGGCGCGGTA TTATCCCGTA TTGACGCGG GCAAGAGCAA CTCGGTCGCC GCATACACTA
5221 TTCTCAGAAT GACTTGGTTG AGTACTCACC AGTCACAGAA AAGCATCTTA CGGATGGCAT
5281 GACAGTAAGA GAATTATGCA GTGCTGCCAT AACCATGAGT GATAAAGCTG CGGCCAACTT
5341 ACTTCTGACA ACGATCGGAG GACCGAAGGA GCTAACCGCT TTTTGCACA ACATGGGGGA
5401 TCATGTAAC TCGCTTGATC GTTGGGAACC GGAGCTGAAT GAAGCCATAC CAAACGACGA
5461 GCGTGACACC ACGATGCCTG TAGCAATGGC AACAACTGTT CGCAAATAT TAACTGGCGA
5521 ACTACTTACT CTAGCTTCCC GGCAACAATT AATAGACTGG ATGGAGGCGG ATAAAGTTGC
5581 AGGACCACTT CTGCGCTCGG CCCTTCCGGC TGGCTGGTTT ATTGCTGATA AATCTGGAGC
5641 CGGTGAGCGT GGTCTCGCG GTATCATGTC AGCACTGGG CCAGATGGTA AGCCCTCCCG
5701 TATCGTAGTT ATCTACACGA CGGGGAGTCA GGCAACTATG GATGAACGAA ATAGACAGAT
5761 CGCTGAGATA GGTGCCTCAC TGATTAAGCA TTGGTAACTG TCAGACCAAG TTTACTCATA
5821 TATACTTTAG ATTGATTTAA AACTTCATTT TTAATTTAAA AGGATCTAGG TGAAGATCCT
5881 TTTTGATAAT CTCATGACCA AAATCCCTTA ACGTGAGTTT TCGTTCCACT GAGCGTCAGA
5941 CCGCGTAGAA AAGATCAAAG GATCTTCTTG AGATCCTTTT TTTCTGCGCG TAATCTGCTG
6001 CTTGCAAACA AAAAAACCAC CGCTACCAGC GGTGGTTTGT TTGCCGGATC AAGAGCTACC-

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6061 AACTCTTTTT CCGAAGGTAA CTGGCTTCAG CAGAGCGCAG ATACCAAATA CTGTCCTTCT
6121 AGTGTAGCCG TAGTTAGGCC ACCACTTCAA GAACTCTGTA GCACCGCCTA CATACCTCGC
6181 TCTGCTAATC CTGTTACCAG TGGCTGCTGC CAGTGGCGAT AAGTCGTGTC TTACCGGGTT
6241 GGAACAAGA CGATAGTTAC CGGATAAGGC GCAGCGGTCG GGCTGAACGG GGGGTTCTGT
6301 CACACAGCCC AGCTTGGAGC GAACGACCTA CACCGAACTG AGATACCTAC AGCGTGAGCT
6361 ATGAGAAAAGC GCCACGCTTC CCGAAGGGAG AAAGGCGGAC AGGTATCCGG TAAGCGGCAG
6421 GGTCGGAACA GGAGAGCGCA CGAGGGAGCT TCCAGGGGGA AACGCCTGGT ATCTTTATAG
6481 TCCTGTCGGG TTTCGCCACC TCTGACTTGA GCGTCGATTT TTGTGATGCT CGTCAGGGGG
6541 GCGGAGCCTA TGGAAAAACG CCAGCAACGC GGCCTTTTGA CGGTTCTCTG CCTTTTGCTG
6601 GCCTTTTGCT CACATGTTCT TTCCTGCGTT ATCCCCTGAT TCTGTGGATA ACCGTATTAC
6661 CGCCTTTGAG TGAGCTGATA CCGCTCGCCG CAGCCGAACG ACCGAGCGCA GCGAGTCAGT
6721 GAGCGAGGAA GCGGAAGAGC GCCCAATACG CAAACCGCCT CTCCCCGCGC GTTGGCCGAT
6781 TCATTAATGC AGCTGGCACG ACAGGTTTCC CGACTGGAAA GCGGGCAGTG AGCGCAACGC
6841 AATTAATGTG AGTTAGCTCA CTCATTAGGC ACCCCAGGCT TTACACTTTA TGCTTCCGGC
6901 TCGTATGTTG TGTGGAATG TGAGCGGATA ACAATTTAC ACAGGAAACA GCTATGACCA
6961 TGATTACGCC AAGCGCGCAA TTAACCCTCA CTAAAGGGAA CAAAAGCTGG GTACCGGGCC
7021 CCCCCCT

FIGURE 31D

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Figure 32A: pDEST12.2 CMV Promoter for Eukaryotic Expression, SV40 Promoter/ori for G418 Resistance

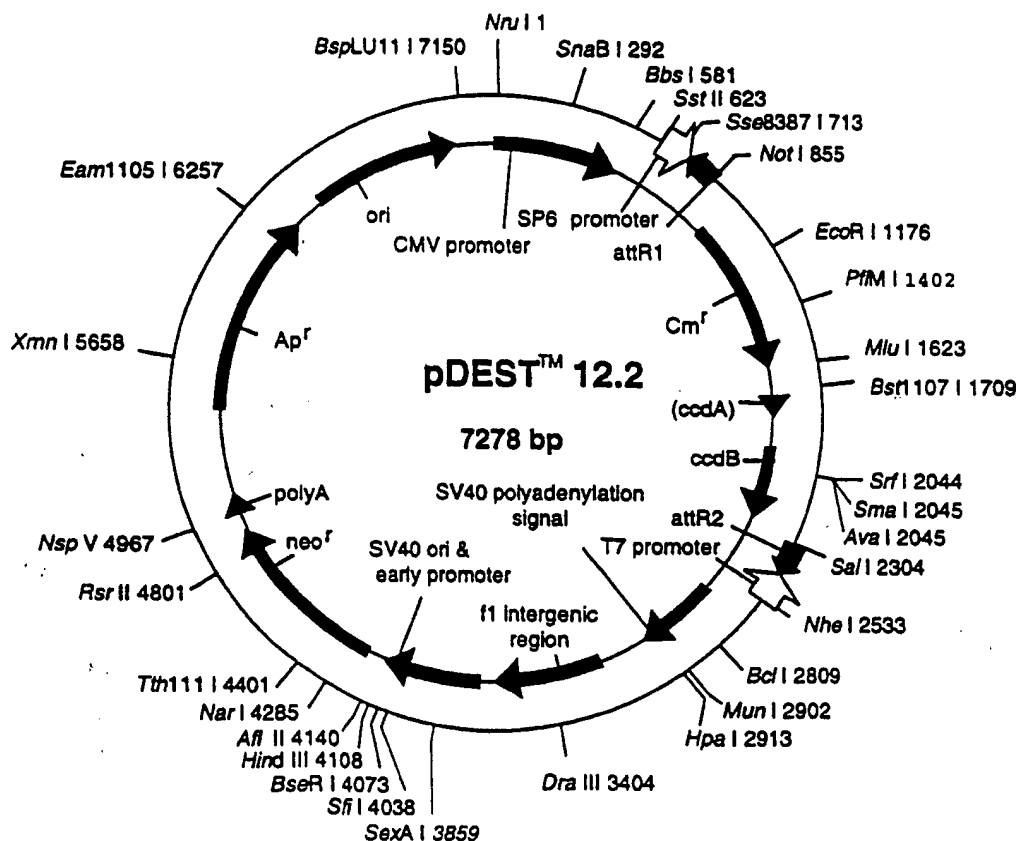
307 *mRNA from CMV promoter*
 acc gtc aga tgc cct gga gac gcc atc cac gct gtt ttg acc tcc ata gaa
 tgg cag tct agc gga cct ctg cgg tag gtg cga caa aac tgg agg tat ctt

358 gac acc ggg acc gat cca gcc tcc gga ctc tag cct agg ccg cgg agc gga
 ctg tgg ccc tgg cta ggt cgg agg cct gag atc gga tcc ggc gcc tcg cct

409 taa caa ttt cac aca gga aac agc tat gac cat tag gcc ttt gca aaa agc
 att gtt aaa gtg tgt cct ttg tgc ata ctg gta atc cgg aaa cgt ttt tcg

460 tat tta ggt gac act ata gaa ggt acg cct gca ggt *Aga* *EcoRI*
 ata aat cca ctg tga tat ctt cca tgc gga cgt cca tgg cca ggc ctt aag
Int *attR1*

511 cca tca ~~aca agt ttg taa ada aaa gct gaa cga gaa acg taa aat gat ata~~
 ggt agt ~~tgt tca aac atg ttg ttt cga cgt gct ctt tgc att tta cta tat~~



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pDEST12.2 7278 bp (rotated to position 3900)

<u>Location (Base Nos.)</u>			<u>Gene Encoded</u>		
86..136			ori		
220..742			CMV promoter		
1059..935			attR1		
1168..1827			CmR		
1947..2031			inactivated ccdA		
2169..2474			ccdB		
2515..2639			attR2		
2824..3186			small t & polyA		
3310..3378			lac		
4363..5157			neo		
5680..6540			ampR		
1	GGGGGGCGGA	GCCTATGGAA	AAACGCCAGC	AACGCGGCCT	TTTTACGGTT
61	TGCTGGCCTT	TTGCTCACAT	GTTCTTTCCT	GCCTTATCCC	CTGATTCTGT
121	ATTACCGCCT	TTGAGTGAGC	TGATACCGCT	CGCCGCAGCC	GAACGACCGA
181	TCAGTGAGCG	AGGAAGCGGA	AGAGCTCGCG	AATGCATGTC	GTTACATAAC
241	TGGCCCGCCT	GGCTGACCGC	CCAACGACCC	CCGCCCATTG	ACGTCAATAA
301	TCCCATAGTA	ACGCCAATAG	GGACTTTCCA	TTGACGTCAA	TGGGTGGAGT
361	AAC TGCCAC	TTGGCAGTAC	ATCAAGTGTA	TCATATGCCA	AGTACGCCCC
421	CAATGACGGT	AAATGGCCCG	CCTGGCATTA	TGCCCAGTAC	ATGACCTTAT
481	TACTTGCGAG	TACATCTACG	TATTAGTCAT	CGCTATTACC	ATGGTGATGC
541	GTACATCAAT	GGGCGTGGAT	AGCGGTTTGA	CTCACGGGGA	TTTCCAAGTC
601	TGACGTCAAT	GGGAGTTTGT	TTTGGCACCA	AAATCAACGG	GACTTTCCAA
661	CAATCCGCGC	CCATTGACGC	AAATGGGCGG	TAGGCGTGTA	CGGTGGGAGG
721	CAGAGCTCGT	TTAGTGAACC	GTCAGATCGC	CTGGAGACGC	CATCCACGCT
781	CCATAGAGTA	CACCGGGACC	GATCCAGCCT	CCGGACTCTA	GCCTAGGCCG
841	AACAATTTCA	CACAGGAAAC	AGCTATGACC	ATTAGGCCTT	TGCAAAAAGC
901	ACACTATAGA	AGGTACGCCT	GCAGGTACCG	GATCACAAGT	TTGTACAAAA
961	AGAAACGTAA	AATGATATAA	ATATCAATAT	ATTAAATTAG	ATTTTGCATA
1021	TACATAATAC	TGTAAAACAC	AACATATCCA	GTCACTATGG	CGGCCGCATT
1081	GGCTTTACAC	TTTATGCTTC	CGGCTCGTAT	AATGTGTGGA	TTTTGAGTTA
1141	AGATTTTCAG	GAGCTAAGGA	AGCTAAAATG	GAGAAAAAAA	TCACTGGATA
1201	GATATATCCC	AATGGCATCG	TAAAGAACAT	TTTGAGGCAT	TTCAGTCAGT
1261	ACCTATAACC	AGACCGTTCA	GCTGGATATT	ACGGCCTTTT	TAAAGACCGT
1321	AAGCACAACT	TTTATCCGGC	CTTTATTACG	ATTCTTGCCC	GCCTGATGAA
1381	GAATTCCGTA	TGGCAATGAA	AGACGGTGAG	CTGGTGATAT	GGGATAGTGT
1441	TACACCGTTT	TCCATGAGCA	AACTGAAACG	TTTTCATCGC	TCTGGAGTGA
1501	GATTTCCGGC	AGTTTCTACA	CATATATTCG	CAAGATGTGG	CGTGTTACGG
1561	GCCTATTTCC	CTAAAGGGTT	TATTGAGAAT	ATGTTTTTTCG	TCTCAGCCAA
1621	AGTTTCCACCA	GTTTTGATTT	AAACGTGGCC	AATATGGACA	ACTTCTTCGC
1681	ACCATGGGCA	AATATTATAC	GCAAGGCGAC	AAGGTGCTGA	TGCCGCTGGC
1741	CATCATGCCG	TCTGTGATGG	CTTCCATGTC	GGCAGAATGC	TTAATGAATT
1801	TGCGATGAGT	GGCAGGGCGG	GGCGTAAACG	CGTGGATCCG	GCTTACTAAA
1861	CAGTATGCGT	ATTTGCGCGC	TGATTTTTGC	GGTATAAGAA	TATATACTGA
1921	CGAAGTATGT	CAAAAAGAGG	TGTCTATGTA	AGCAGCGTAT	TACAGTGACA
1981	ACAGCTATCA	GTTGCTCAAG	GCATATATGA	TGTCAATATC	TCCGGTCTGG
2041	CATGCAGAAT	GAAGCCCGTC	GTCTGCGTGC	CGAACGCTGG	AAAGCGGAAA
2101	GATGGCTGAG	GTCGCCCCGT	TTATTGAAAT	GAACGGCTCT	TTTGCTGACG
2161	CTGGTGAAAT	GCAGTTTAAG	GTTTACACCT	ATAAAAGAGA	GAGCCGTTAT
2221	TGGATGTACA	GAGTGATATT	ATTGACACGC	CCGGGCGACG	GATGGTGATC
2281	GTGCACGTCT	GCTGTCAGAT	AAAGTCTCCC	GTGAACTTTA	CCCGGTGGTG
2341	ATGAAAGCTG	GCGCATGATG	ACCACCGATA	TGGCCAGTGT	GCCGGTCTCC
2401	AAGAAGTGCG	TGATCTCAGC	CACCGCGAAA	ATGACATCAA	AAACGCCATT

FIGURE 32B

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2461 TCTGGGGAAT ATAAATGTCA GGCTCCCTTA TACACAGCCA GTCTGCAGGT CGACCATAGT
2521 GACTGGATAT GTTGTGTTTT ACAGTATTAT GTAGTCTGTT TTTTATGCAA AATCTAATTT
2581 AATATATTGA TATTTATATC ATTTTACGTT TCTCGTTCAG CTTTCTTGTA CAAAGTGGTG
2641 ATCGCGTGCA TGCGACGTCA TAGCTCTCTC CCTATAGTGA GTCGTATTAT AAGCTAGGCA
2701 CTGGCCGTCG TTTTACAACG TCGTGACTGG GAAAAC TGCT AGCTTGGGAT CTTTGTGAAG
2761 GAACCTTACT TCTGTGGTGT GACATAATTG GACAACTAC CTACAGAGAT TTAAAGCTCT
2821 AAGGTAAATA TAAAATTTTT AAGTGTATAA TGTGTTAAAC TAGCTGCATA TGCTTGCTGC
2881 TTGAGAGTTT TGCTTACTGA GTATGATTTA TGAAAATATT ATACACAGGA GCTAGTGATT
2941 CTAATTGTTT GTGTATTTTA GATTCACAGT CCCAAGGCTC ATTTTCAGGCC CCTCAGTCCT
3001 CACAGTCTGT TCATGATCAT AATCAGCCAT ACCACATTTG TAGAGGTTTT ACTTGCTTTA
3061 AAAAACCTCC CACACCTCCC CCTGAACCTG AAACATAAAA TGAATGCAAT TGTGTTGTT
3121 AACTTGTTTA TTGCAGCTTA TAATGGTTAC AAATAAAGCA ATAGCATCAC AAATTTTACA
3181 AATAAAGCAT TTTTTTCACT GCATTCTAGT TGTGGTTTTGT CCAAAC TCAT CAATGTATCT
3241 TATCATGTCT GGATCGATCC TGCATTAATG AATCGGCCAA CGCGCGGGGA GAGGCGGTTT
3301 GCGTATTGGC TGGCGTAATA GCGAAGAGGC CCGCACC GAT CGCCCTTCCC AACAGTTGCG
3361 CAGCCTGAAT GCGGAATGGG ACGCGCCCTG TAGCGGCGCA TTAAGCGCGG CGGGTGTGGT
3421 GGTACGCGC AGCGTGACCG CTACACTTGC CAGCGCCCTA GCGCCCGCTC CTTTCGCTTT
3481 CTTCCCTTCC TTTCTCGCCA CGTTCGCGCG CTTTCCCCGT CAAGCTCTAA ATCGGGGGCT
3541 CCCTTTAGGG TTCCGATTTA GTGCTTTACG GCACCTCGAC CCCAAAAAC TTGATTAGGG
3601 TGATGTTTCA CGTAGTGGGC CATCGCTCTG ATAGACGGTT TTTGCGCCTT TGACCTTGGA
3661 GTCCACGTTT TTTAATAGTG GACTCTTGTT CCAAAC TGGA ACAACACTCA ACCCTATCTC
3721 GGTCTATTCT TTTGATTTAT AAGGGATTTT GCCGATTTG GCCTATTGGT TAAAAAATGA
3781 GCTGATTTAA CAAATATTTA ACGCGAATTT TAACAAAATA TTAACGTTTA CAATTTTCGCC
3841 TGATGCGGTA TTTTCTCCTT ACGCATCTGT GCGGTATTTT ACACCGCATA CGCGGATCTG
3901 CGCAGCACCA TGGCCTGAAA TAACCTCTGA AAGAGGAACT TGGTTAGGTA CCTTCTGAGG
3961 CGGAAAGAAC CAGCTGTGGA ATGTGTGTCA GTTAGGGTGT GGAAAGTCCC CAGGCTCCCC
4021 AGCAGGCAGA AGTATGCAAA GCATGCATCT CAATTAGTCA GCAACCAGGT GTGGAAAGTC
4081 CCCAGGCTCC CCAGCAGGCA GAAGTATGCA AAGCATGCAT CTCAATTAGT CAGCAACCAT
4141 AGTCCGCCCC CTAACCTCCG CCATCCCGCC CTAACCTCCG CCCAGTTCCG CCCATTCTCC
4201 GCCCCATGGC TGAATAATTT TTTTATTTA TGCAGAGGCC GAGGCCGCTT CGGCCTCTGA
4261 GCTATTCCAG AAGTAGTGAG GAGGCTTTTT TGGAGGCCTA GGCTTTTGCA AAAAGTTGA
4321 TTCTTCTGAC ACAACAGTCT CGAACTTAAG GCTAGAGCCA CCATGATTGA ACAAGATGGA
4381 TTGCACGCAG GTTCTCCGGC CGCTTGGGTG GAGAGGCTAT TCGGCTATGA CTGGGCACAA
4441 CAGACAAATCG GCTGCTCTGA TGCCGCCGTG TTCCGGCTGT CAGCGCAGGG GCGCCCGGTT
4501 CTTTTGTGCA AGACCGACCT GTCCGGTGCC CTGAATGAAC TGCAGGACGA GGCAGCGCGG
4561 CTATCGTGGC TGGCCACGAC GGGCGTTCCT TGCGCAGCTG TGCTCGACGT TGTCACTGAA
4621 GCGGGAAGGG ACTGGCTGCT ATTGGGCGAA GTGCCGGGGC AGGATCTCCT GTCATCTCAC
4681 CTGTCTCCTG CCGAGAAAGT ATCCATCATG GCTGATGCAA TGCGGCGGCT GCATACGCTT
4741 GATCCGGCTA CCTGCCCATT CGACCACCAA GCGAAACATC GCATCGAGCG AGCACGTACT
4801 CGGATGGAAG CCGGTCTTGT CGATCAGGAT GATCTGGACG AAGAGCATCA GGGGCTCGCG
4861 CCAGCCGAAC TGTTCCGCCG GCTCAAGGCG CGCATGCCCG ACGGCGAGGA TCTCGTCTGT
4921 ACCCATGGCG ATGCCTGCTT GCCGAATATC ATGGTGGAAT ATGGCCGCTT TTCTGGATT
4981 ATCGACTGTG GCCGGCTGGG TGTGGCGGAC CGCTATCAGG ACATAGCGTT GGCTACCCGT
5041 GATATTGCTG AAGAGCTTGG CGGCGAATGG GCTGACCGCT TCCTCGTGCT TTACGGTATC
5101 GCCGTCCCCG ATTCGCAGCG CATCGCCTTC TATCGCCTTC TTGACGAGTT CTTCTGAGCG
5161 GGA CTCTGGG GTTCGAAATG ACCGACCAAG CGACGCCCAA CCTGCCATCA CGATGGCCGC
5221 AATAAAATAT CTTTATTTTC ATTACATCTG TGTGTTGGTT TTTTGTGTGA ATCGATAGCG
5281 ATAAGGATCC GCGTATGGTG CACTCTCAGT ACAATCTGCT CTGATGCCGC ATAGTTAAGC
5341 CAGCCCCGAC ACCCGCCAAC ACCCGCTGAC GCGCCCTGAC GGGCTTGCTT GCTCCCGGCA
5401 TCCGCTTACA GACAAGCTGT GACCGTCTCC GGGAGCTGCA TGTGTCAGAG GTTTTCACCG
5461 TCATCACCAG AACGCGCGAG ACGAAAAGGC CTCGTGATAC GCCTATTTT ATAGSTTAAT
5521 GTCATGATAA TAATGGTTTC TTAGACGTCA GGTGGCACTT TTCGGGGAAA TGTGCGCGGA
5581 ACCCTATTTT GTTTATTTTT CTAAATACAT TCAAATATGT ATCCGCTCAT GAGACAATAA
5641 CCCTGATAAA TGCTTCAATA ATATTGAAAA AGGAAGAGTA TGAGTATTCA ACATTTCCGT
5701 GTCGCCCTTA TTCCCTTTTT TGCGGCATTT TGCCTTCCTG TTTTGTCTCA CCCAGAAACG
5761 CTGGTGAAAG TAAAAGATGC TGAAGATCAG TTGGGTGCAC GAGTGGGTTA CATCGAACTG
5821 GATCTCAACA GCGGTAAGAT CCTTGAGAGT TTTGCCCCG AAGAACGTTT TCCAATGATG
5881 AGCACTTTTA AAGTTCTGCT ATGTGGCGCG GTATTATCCC GTATTGACGC CGGGCAAGAG-

FIGURE 32C

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5941 CAACTCGGTC GCCGCATACA CTATTCTCAG AATGACTTGG TTGAGTACTC ACCAGTCACA
6001 GAAAAGCATC TTACGGATGG CATGACAGTA AGAGAATTAT GCAGTGCTGC CATAACCATG
6061 AGTGATAACA CTGCGGCCAA CTTACTTCTG ACAACGATCG GAGGACCGAA GGAGCTAACC
6121 GCTTTTTTGC ACAACATGGG GGATCATGTA ACTCGCCTTG ATCGTTGGGA ACCGGAGCTG
6181 AATGAAGCCA TACCAAACGA CGAGCGTGAC ACCACGATGC CTGTAGCAAT GGCAACAACG
6241 TTGCGCAAAC TATTAAC TGG CGAACTACTT ACTCTAGCTT CCCGGCAACA ATTAATAGAC
6301 TGGATGGAGG CGGATAAAGT TGCAGGACCA CTTCTGCGCT CGGCCCTTCC GGCTGGCTGG
6361 TTTATTGCTG ATAAATCTGG AGCCGGTGAG CGTGGGTCTC GCGGTATCAT TGCAGCACTG
6421 GGGCCAGATG GTAAGCCCTC CCGTATCGTA GTTATCTACA CGACGGGGAG TCAGGCAACT
6481 ATGGATGAAC GAAATAGACA GATCGCTGAG ATAGGTGCCT CACTGATTAA GCATTGGTAA
6541 CTGTCAGACC AAGTTTACTC ATATATACTT TAGATTGATT TAAAACCTCA TTTTAAATTT
6601 AAAAGGATCT AGGTGAAGAT CCTTTTGTAT AATCTCATGA CCAAAATCCC TTAACGTGAG
6661 TTTTCGTTCC ACTGAGCGTC AGACCCCGTA GAAAAGATCA AAGGATCTTC TTGAGATCCT
6721 TTTTTTCTGC GCGTAATCTG CTGCTTGCAA AAAAAAAAAAC CACCGCTACC AGCGGTGGTT
6781 TGTTTGCCGG ATCAAGAGCT ACCAACTCTT TTTCCGAAGG TAACTGGCTT CAGCAGAGCG
6841 CAGATACCAA ATACTGTCCT TCTAGTGTAG CCGTAGTTAG GCCACCACTT CAAGAACTCT
6901 GTAGCACCGC CTACATACCT CGCTCTGCTA ATCCTGTTAC CAGTGGCTGC TGCCAGTGGC
6961 GATAAGTCGT GTCTTACCGG GTTGGACTCA AGACGATAGT TACCGGATAA GGCGCAGCGG
7021 TCGGGCTGAA CGGGGGGTTC GTGCACACAG CCCAGCTTGG AGCGAACGAC CTACACCGAA
7081 CTGAGATACC TACAGCGTGA GCATTGAGAA AGCGCCACGC TTCCCGAAGG GAGAAAGGCG
7141 GACAGGTATC CGGTAAGCGG CAGGGTCGGA ACAGGAGAGC GCACGAGGGA GCTTCCAGGG
7201 GGAAACGCCT GGTATCTTTA TAGTCCTGTC GGGTTTCGCC ACCTCTGACT TGAGCGTCGA
7261 TTTTTGTGAT GCTCGTCA

FIGURE 32D

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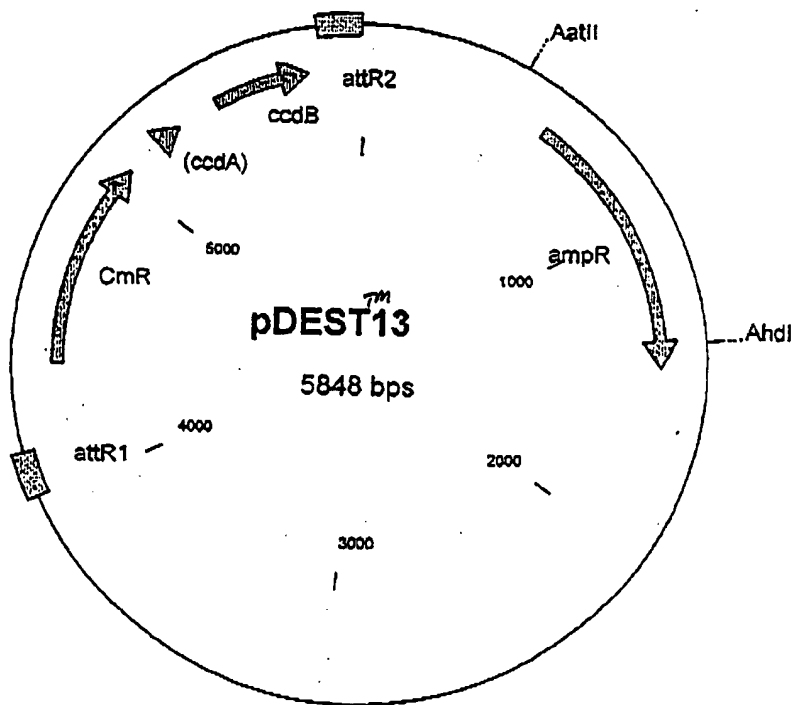
Figure 33A:

pDEST13

Native protein in E. coli: λ PL
promoter

3721 tgggcaaacc aagacagcta aagatctctc acctacaaa caatgcccc ctgcaaaaaa
 acccgtttgg ttctgtcgat ttctagagag tggatggttt gttacggggg gacgtttttt
 3781 taaattcata taaaaaacat acagataacc atctgcgggtg ataaattatc tctggcgggtg
 atttaagtat attttttgta tgtctattgg tagacgccac tatttaatag agaccgccac
 3841 ttgacataaa taccactggc ggtgatactg agcacatcag caggacgcac tgaccaccat
aactgtattt atgggtgaccg ccactatgac tcgtgtagtc gtcctgcgtg actggtggta
 3901 gaaggtgacg ctcttaaaaa ttaagecctg aagaaggga gcattcaaag cagaaggctt
 ctccactgc gagaattttt aattcgggac ctctcccg cgtaagtttc gtcttccgaa
 3961 tggggtgtgt gatacgaac gaagcattgg gatcatcaca agtttgtaca aaaaagctga
 accccacaca ctatgctttg cttcgtaacc ctagtagtgt tcaaacatgt ttttccgact

-35 λ PL Promoter -10
 E. coli
 mRNA
 EcoRI
 att R1
 att R2



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pDEST13 5848 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
599..1458		ampR
4123..3998		attR1
4372..5031		CmR
5151..5235		inactivated ccdA
5373..5678		ccdB
5719..5843		attR2
1	TTCACCTGGCC GTCGTTTTAC AACGTCGTGA CTGGGAAAAC CCTGGCGTTA CCCAACTTAA	
61	TCGCCCTTGCA GCACATCCCC CTTTCGCCAG CTGGCGTAAT AGCGAAGAGG CCCGCACCGA	
121	TCGCCCTTCC CAACAGTTGC GCAGCCTGAA TGGCGAATGG CGCCTGATGC GGTATTTTCT	
181	CCTTACGCAT CTGTGCGGTA TTTACACCG CATATGGTGC ACTCTCAGTA CAATCTGCTC	
241	TGATGCCGCA TAGTTAAGCC AGCCCCGACA CCCGCCAACA CCCGCTGACG CGCCCTGACG	
301	GGCTTGCTCG CTCCCGGCAT CCGCTTACAG ACAAGCTGTG ACCGTCTCCG GGAGCTGCAT	
361	GTGTCAGAGG TTTTACCCTG CATCACCGAA ACGCGCGAGA CGAAAGGGCC TCGTGATACG	
421	CCTATTTTTA TAGGTTAATG TCATGATAAT AATGGTTTCT TAGACGTCAG GTGGCACTTT	
481	TCGGGGAAAT GTGCGCGGAA CCCCTATTTG TTTATTTTTC TAAATACATT CAAATATGTA	
541	TCCGCTCATG AGACAATAAC CCTGATAAAT GCTTCAATAA TATTGAAAAA GGAAGAGTAT	
601	GAGTATTCAA CATTTCCGTG TCGCCCTTAT TCCCTTTTTT GCGGCATTTT GCCTTCCTGT	
661	TTTTGCTCAC CCAGAAACGC TGGTGAAAGT AAAAGATGCT GAAGATCAGT TGGGTGCACG	
721	AGTGGGTTAC ATCGAACTGG ATCTCAACAG CGGTAAGATC CTTGAGAGTT TTCGCCCCGA	
781	AGAACGTTTT CCAATGATGA GCACTTTTAA AGTTCTGCTA TGTGGCGCGG TATTATCCCCG	
841	TATTGACGCC GGGCAAGAGC AACTCGGTGCG CCGCATACAC TATTCTCAGA ATGACTTGGT	
901	TGAGTACTCA CCACTCACAG AAAAGCATCT TACGGATGGC ATGACAGTAA GAGAATTATG	
961	CAGTGCTGCC ATAACCATGA GTGATAACAC TCGCGCCAAC TTACTTCTGA CAACGATCGG	
1021	AGGACCGAAG GAGCTAACCG CTTTTTTGCA CAACATGGGG GATCATGTAA CTCGCCCTGA	
1081	TCGTTGGGAA CCGGAGCTGA ATGAAGCAT ACCAAACGAC GAGCGTGACA CCACGATGCC	
1141	TGTAGCAATG GCAACAACGT TGCGCAAACT ATTAAGTGGC GAACTACTTA CTCTAGCTTC	
1201	CCGGCAACAA TTAATAGACT GGATGGAGGC GGATAAAGTT GCAGGACCAC TTCTGCGCTC	
1261	GGCCCTTCCG GCTGGCTGGT TTATTGCTGA TAAATCTGGA GCCGGTGAGC GTGGGTCTCG	
1321	CGGTATCATT GCAGCACTGG GGCCAGATGG TAAGCCCTCC CGTATCGTAG TTATCTACAC	
1381	GACGGGGAGT CAGGCAACTA TGGATGAACG AAATAGACAG ATCGCTGAGA TAGGTGCCTC	
1441	ACTGATTAAG CATTGGTAAC TGTCAGACCA AGTTTACTCA TATATACTTT AGATTGATTT	
1501	AAAATTCAT TTTTAATTTA AAAGGATCTA GGTGAAGATC CTTTTTGATA ATCTCATGAC	
1561	CAAAATCCCT TAACGTGAGT TTTTCGTTCCA CTGAGCGTCA GACCCCGTAG AAAAGATCAA	
1621	AGGATCTTCT TGAGATCCTT TTTTCTGCG CGTAATCTGC TGCTTGCAAA CAAAAAACC	
1681	ACCGTACCA GCGGTGGTTT GTTTGCCGGA TCAAGAGCTA CCAACTCTTT TTCCGAAGGT	
1741	AACTGGCTTC AGCAGAGCGC AGATACCAAA TACTGTTCTT CTAGTGAGC CGTAGTTAGG	
1801	CCACCACTTC AAGAACTCTG TAGCACCGCC TACATACCTC GCTCTGCTAA TCCTGTTACC	
1861	AGTGGCTGCT GCCAGTGGCG ATAAGTCGTG TCTTACCGGG TTGGACTCAA GACGATAGTT	
1921	ACCGGATAAG GCGCAGCGGT CGGGCTGAAC GGGGGGTTCC TGCACACAGC CCAGCTTGGA	
1981	GCGAACGACC TACACCGAAC TGAGATACCT ACAGCGTGAG CATTGAGAAA GCGCCACGCT	
2041	TCCCGAAGGG AGAAAGGCGG ACAGGTATCC GGTAAGCGGC AGGGTCGGAA CAGGAGAGCG	
2101	CACGAGGGAG CTTCCAGGGG GAAACGCCTG GTATCTTTAT AGTCCTGTCT GGTTCGCCA	
2161	CCTCTGACTT GAGCGTCGAT TTTTGTGATG CTCGTCAGGG GGGCGGAGCC TATGGAAAAA	
2221	CGCCAGCAAC GCGGCCTTTT TACGGTTTCT GGCCTTTTGC TGGCCTTTTG CTCACATGTT	
2281	CTTTCCTGCG TTATCCCCTG ATTCTGTGGA TAACCGTATT ACCGCCTTTG AGTGAGCTGA	
2341	TACCGCTCGC CGCAGCCGAA CGACCGAGCG CAGCGAGTCA GTGAGCGAGG AAGCGGAAGA	
2401	GCGCCCAATA CGCAAACCGC CTCTCCCCGC GCGTTGGCCG ATTCATTAAT GCAGCTGGCA	
2461	CGACAGGTTT CCCGACTGGA AAGCGGGCAG TGAGCGCAAC GCAATTAATG TGAGTTAGCT	
2521	CACTCATTAG GCACCCAGG CTTTACACTT TATGCTTCCG GCTCGTATGT TGTGTGGAAT	
2581	TGTGAGCGGA TAACAATTTT ACACAGGAAA CAGCTATGAC CATGATTACG CCAAGCTTGG	
2641	CTGCAGGTGA TGATTATCAG CCAGCAGAGA TTAAGGAAAA CAGACAGGTT TATTGAGCGC	
2701	TTATCTTTCC CTTTATTTTT GCTGCGGTAA GTCGCATAAA AACCATTCTT CATAATTCAA	

FIGURE 33B

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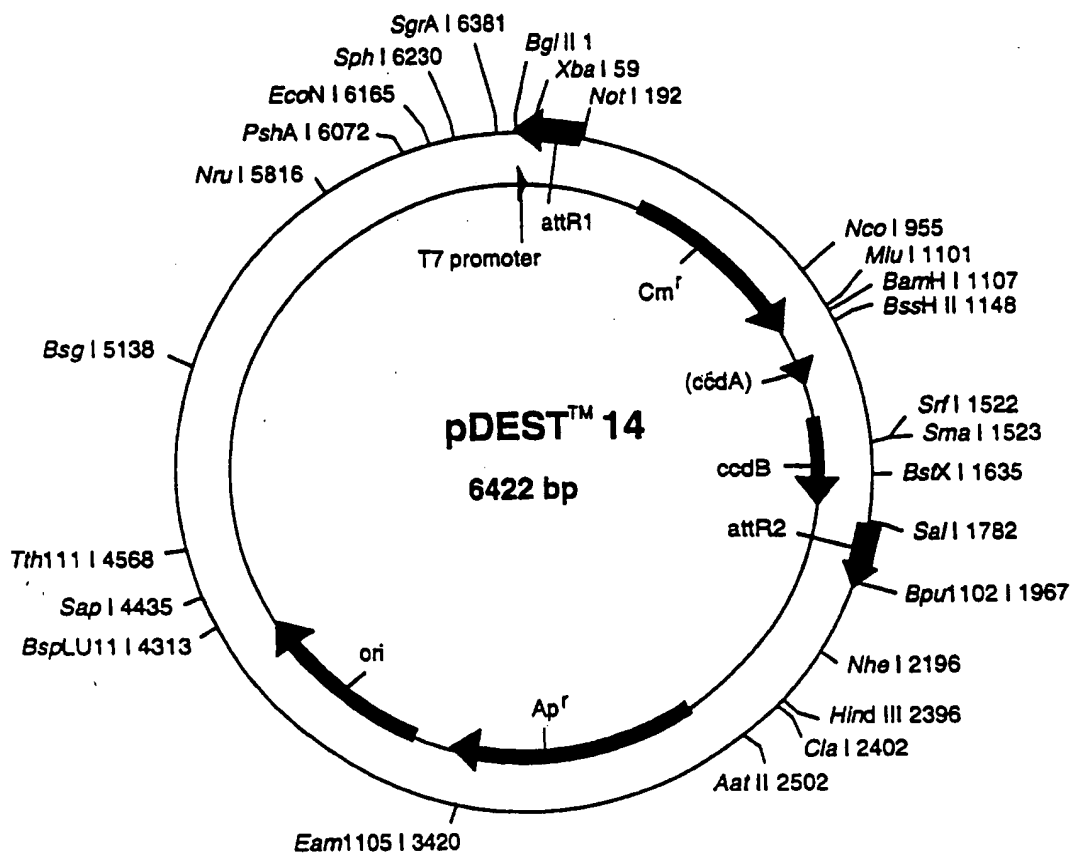
2761 TCCATTTACT ATGTTATGTT CTGAGGGGAG TGAAAATTCC CCTAATTCTGA TGAAGATTCT
2821 TGCTCAATTG TTATCAGETA TGC GCCGACC AGAACACCTT GCCGATCAGC CAAACGTCTC
2881 TTCAGGCCAC TGACTAGCGA TAACTTTCCC CACAACGGAA CAACTCTCAT TGCATGGGAT
2941 CATTGGGTAC TGTGGGTTTA GTGGTTGTAA AAACACCTGA CCGCTATCCC TGATCAGTTT
3001 CTTGAAGGTA AACTCATCAC CCCCAAGTCT GGCTATGCAG AAATCACCTG GCTCAACAGC
3061 CTGCTCAGGG TCAACGAGAA TTAACATTCC GTCAGGAAAG CTTGGCTTGG AGCCTGTTGG
3121 TGCGGTCATG GAATTACCTT CAACCTCAAG CCAGAATGCA GAATCACTGG CTTTTTTGGT
3181 TGTGCTTACC CATCTCTCCG CATCACCTTT GGTAAAGGTT CTAAGCTTAG GTGAGAACAT
3241 CCCTGCCCTGA ACATGAGAAA AAACAGGGTA CTCATACTCA CTTCTAAGTG ACGGCTGCAT
3301 ACTAACCGCT TCATACATCT CGTAGATTTT TCTGGCGATT GAAGGGCTAA ATTCTTCAAC
3361 GCTAACTTTG AGAATTTTTG CAAGCAATGC GCGGTTATAA GCATTTAATG CATTGATGCC
3421 ATTAAATAAA GCACCAACGC CTGACTGCCC CATCCCCATC TTGTCTGCGA CAGATTCTCG
3481 GGATAAGCCA AGTTCATTTT TCTTTTTTTC ATAAATTGCT TTAAGGCGAC GTGCGTCTC
3541 AAGCTGCTCT TGTGTTAATG GTTCTTTTTT TGTGCTCATA CGTTAAATCT ATCACCAGCA
3601 GGGATAAATA TCTAACACCG TGCGTGTGTA CTATTTTACC TCTGGCGGTG ATAATGGTTG
3661 CATGTACTAA GGAGGTTGTA TGGAACAACG CATAACCCTG AAAGATTATG CAATGCGCTT
3721 TGGGCAAACC AAGACAGCTA AAGATCTCTC ACCTACCAA CAATGCCCCC CTGCAAAAAA
3781 TAAATTCATA TAAAAACAT ACAGATAACC ATCTGCGGTG ATAAATTATC TCTGGCGGTG
3841 TTGACATAAA TACCCTGGC GGTGATACTG AGCACATCAG CAGGACGCAC TGACCACCAT
3901 GAAGGTGACG CTCTTAAAAA TTAAGCCCTG AAGAAGGGCA GCATTCAAAG CAGAAGGCTT
3961 TGGGGTGTGT GATACGAAAC GAAGCATTGG GATCATCACA AGTTTGTACA AAAAAGCTGA
4021 ACGAGAAACG TAAATGATA TAAATATCAA TATATTAAAT TAGATTTTGC ATAAAAAACA
4081 GACTACATAA TACTGTAAAA CACAACATAT CCAGTCACTA TGGCGGCCCG TAAGTTGGCA
4141 GCATCACCCG ACGCACTTTG CGCCGAATAA ATACCTGTGA CGGAAGATCA CTTGCGAGAA
4201 TAAATAAATC CTGGTGCTCC GTTGTATACC GGAAGCCCT GGGCCAACCT TTGGCGAAAA
4261 TGAGACGTTG ATCGGCACGT AAGAGGTTCC AACTTTCACC ATAATGAAAT AAGATCACTA
4321 CCGGGCGTAT TTTTGTAGTT ATCGAGATT TCAGGAGCTA AGGAAGCTAA AATGGAGAAA
4381 AAAATCACTG GATATACCAC CGTTGATATA TCCCAATGGC ATCGTAAAGA ACATTTTGAG
4441 GCATTTTCAGT CAGTTGCTCA ATGTACCTAT AACCAGACCG TTCAGCTGGA TATTACGGCC
4501 TTTTTAAAGA CCGTAAAGAA AAATAAGCAC AAGTTTTATC CGGCCTTTAT TCACATTCTT
4561 GCGCGCTGA TGAATGCTCA TCCGGAATTC CGTATGGCAA TGAAAGACGG TGAGCTGGTG
4621 ATATGGGATA GTGTTACCCC TTGTTACACC GTTTTCCATG AGCAAAGTGA AACGTTTTCA
4681 TCGCTCTGGA GTGAATACCA CGACGATTTT CGGCAGTTTC TACACATATA TTCGCAAGAT
4741 GTGGCGTGT ACGGTGAAAA CCTGGCCTAT TTCCCTAAAG GGTATTATGA GAATATGTTT
4801 TTCGTCTCAG CCAATCCCTG GGTGAGTTTC ACCAGTTTTG ATTTAAACGT GGCCAATATG
4861 GACAACCTCT TCGCCCCCGT TTTCACCATG GGCAAATATT ATACGCAAGG CGACAAGGTG
4921 CTGATGCCGC TGGCGATTCA GGTTCATCAT GCCGTCTGTG ATGGCTTCCA TGTCGGCAGA
4981 ATGCTTAATG AATTACAACA GTACTGCGAT GAGTGGCAGG GCGGGGCGTA AACGCGTGGA
5041 TCCGGCTTAC TAAAAGCCAG ATAACAGTAT GCGTATTTGC GCGCTGATTT TTGCGGTATA
5101 AGAATATATA CTGATATGTA TACCCGAAGT ATGTCAAAAA GAGGTGTGCT ATGAAGCAGC
5161 GTATTACAGT GACAGTTGAC AGCGACAGCT ATCAGTTGCT CAAGGCATAT ATGATGTCAA
5221 TATCTCCGGT CTGGTAAGCA CAACCATGCA GAATGAAGCC CGTCGTCTGC GTGCCGAACG
5281 CTGGAAAGCG GAAAATCAGG AAGGGATGGC TGAGGTCGCC CGGTTTATTG AAATGAACGG
5341 CTCTTTTGCT GACGAGAACA GGGACTGGTG AAATGCAGTT TAAGGTTTAC ACCTATAAAA
5401 GAGAGAGCCG TTATCGTCTG TTTGTGGATG TACAGAGTGA TATTATTGAC ACGCCCGGGC
5461 GACGGATGGT GATCCCCCTG GCCAGTGCAC GTCTGCTGTC AGATAAAGTC TCCCGTGAAC
5521 TTTACCCGGT GGTGCATATC GGGGATGAAA GCTGGCGCAT GATGACCACC GATATGGCCA
5581 GTGTGCCGGT CTCCGTTATC GGGGAAGAAG TGGCTGATCT CAGCCACCGC GAAAATGACA
5641 TCAAAAACGC CATTAACCTG ATGTTCTGGG GAATATAAAT GTCAGGCTCC GTTATACACA
5701 GCCAGTCTGC AGGTCGACCA TAGTGACTGG ATATGTTGTG TTTTACAGTA TTATGTAGTC
5761 TGTTTTTTAT GCAAAATCTA ATTTAATATA TTGATATTTA TATCATTTTA CGTTTCTCGT
5821 TCAGCTTTCT TGTACAAAGT GGTGATAA

FIGURE 33C

Figure 34A: pDEST14 Native Protein Expression in *E. coli*, T7 Promoter

3961 tgcgggcccac gatgcgtccg gcgtagagga tgcgagatctc gatcccgcca aatttaatacg
 acggccggtg ctaccgcaggc cgcattctcct agctctagag ctaggggcgt ttaattatgc
 4021 // actcactata gggagaccac aacggtttcc ctctagatca caagttttta caaaaaagct
 // tgagtgatat ccctctggtg ttgccaaagg gagatctagt gttcaaacat gttttttcga //

Handwritten annotations: *Bgl* II, *Asp* I, *PT* 7, *Xba* I, *Eco* RI, *Not* I.



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pDEST14 6422 bp (rotated to position 4000)

<u>Location (Base Nos.)</u>				<u>Gene Encoded</u>		
185..61				attR1		
435..1094				CmR		
1214..1298				inactivated ccdA		
1436..1741				ccdB		
1782..1906				attR2		
2632..3489				ampR		
1	CGATCCCGCG	AAATTAATAC	GACTCACTAT	AGGGAGACCA	CAACGGTTTC	CCTCTAGATC
61	ACAAGTTTGT	ACAAAAAAGC	TGAACGAGAA	ACGTAAAATG	ATATAAATAT	CAATATATTA
121	AATTAGATTT	TGCATAAAAA	ACAGACTACA	TAATACTGTA	AAACACAACA	TATCCAGTCA
181	CTATGGCGGC	CGCTAAGTTG	GCAGCATCAC	CCGACGCACT	TTGCGCCGAA	TAAATACCTG
241	TGACGGAAGA	TCACTTCGCA	GAATAAATAA	ATCCTGGTGT	CCCTGTTGAT	ACCGGGAAGC
301	CCTGGGCCAA	CTTTTGGCGA	AAATGAGACG	TTGATCGGCA	CGTAAGAGGT	TCCAAC TTTC
361	ACCATAATGA	AATAAGATCA	CTACCGGGCG	TATTTTTTGA	GTTATCGAGA	TTTTCAGGAG
421	CTAAGGAAGC	TAAAATGGAG	AAAAAATCA	CTGGATATAC	CACCGTTGAT	ATATCCCAAT
481	GGCATCGTAA	AGAACATTTT	GAGGCATTTT	AGTCAGTTGC	TCAATGTACC	TATAACCAGA
541	CCGTTTCAGCT	GGATATTACG	GCCTTTTTTAA	AGACCGTAAA	GAAAAATAAG	CACAAGTTTT
601	ATCCGGCCTT	TATTCACATT	CTTGCCCCGC	TGATGAATGC	TCATCCGGAA	TTCCGTATGG
661	CAATGAAAGA	CGGTGAGCTG	GTGATATGGG	ATAGTGTTCA	CCCTTGTTAC	ACCGTTTTTC
721	ATGAGCAAAC	TGAAACGTTT	TCATCGCTCT	GGAGTGAATA	CCACGACGAT	TTCCGGCAGT
781	TTCTACACAT	ATATTCGCAA	GATGTGGCGT	GTTACGGTGA	AAACCTGGCC	TATTTCCCTA
841	AAGGGTTTAT	TGAGAATATG	TTTTTCGTCT	CAGCCAATCC	CTGGGTGAGT	TTCAACAGTT
901	TTGATTTAAA	CGTGGCCAAT	ATGGACAAC	TCTTCGCCCC	CGTTTTCCAC	ATGGGCAAAT
961	ATTATACGCA	AGGCGACAAG	GTGCTGATGC	CGCTGGCGAT	TCAGGTTTCAT	CATGCCGTCT
1021	GTGATGGCTT	CCATGTGCGC	AGAATGCTTA	ATGAATTACA	ACAGTACTGC	GATGAGTGGC
1081	AGGGCGGGGC	GTAACGCGT	GGATCCGGCT	TACTAAAAGC	CAGATAACAG	TATGCGTATT
1141	TGCGCGCTGA	TTTTTGCGGT	ATAAGAATAT	ATACTGATAT	GTATACCCGA	AGTATGTCAA
1201	AAAGAGGTGT	GCTATGAAGC	AGCGTATTAC	AGTGACAGTT	GACAGCGACA	GCTATCAGTT
1261	GCTCAAGGCA	TATATGATGT	CAATATCTCC	GGTCTGGTAA	GCACAACCAT	GCAGAATGAA
1321	GCCCCGTCGT	TGCGTGCCGA	ACGCTGGAAA	GCGGAAAATC	AGGAAGGGAT	GGCTGAGGTC
1381	GCCCCGTTTA	TTGAAATGAA	CGGCTCTTTT	GCTGACGAGA	ACAGGGACTG	GTGAAATGCA
1441	GTTTAAGGTT	TACACCTATA	AAAGAGAGAG	CCGTTATCGT	CTGTTTGTGG	ATGTACAGAG
1501	TGATATTATT	GACACGCCCC	GGCGACGGAT	GGTGATCCCC	CTGGCCAGTG	CACGTCTGCT
1561	GTCAGATAAA	GTCTCCCGTG	AACTTTACCC	GGTGGTGAT	ATCGGGGATG	AAAGCTGGCG
1621	CATGATGACC	ACCGATATGG	CCAGTGTTGC	GGTCTCCGTT	ATCGGGGAAG	AAGTGGCTGA
1681	TCTCAGCCAC	CGCGAAAATG	ACATCAAAAA	CGCCATTAAAC	CTGATGTTCT	GGGGAATATA
1741	AATGTCAGGC	TCCCTTATAC	ACAGCCAGTC	TGCAGGTCGA	CCATAGTGAC	TGGATATGTT
1801	GTGTTTTACA	GTATTATGTA	GTCTGTTTTT	TATGCAAAAT	CTAATTTAAT	ATATTGATAT
1861	TTATATCATT	TTACGTTTCT	CGTTCAGCTT	TCTTGTAACA	AGTGGTGATG	ATCCGGCTGC
1921	TAACAAAGCC	CGAAAGGAAG	CTGAGTTGGC	TGCTGCCACC	GCTGAGCAAT	AACTAGCATA
1981	ACCCCTTGGG	GCCTCTAAAC	GGGTCTTGAG	GGGTTTTTTG	CTGAAAGGAG	GAACTATATC
2041	CGGATATCCA	CAGGACGGGT	GTGGTCGCCA	TGATCGCGTA	GTCGATAGTG	GCTCCAAGTA
2101	GCGAAGCGAG	CAGGACTGGG	CGGCGGCCAA	AGCGGTCGGA	CAGTGCTCCG	AGAACGGGTG
2161	CGCATAGAAA	TTGCATCAAC	GCATATAGCG	CTAGCAGCAC	GCCATAGTGA	CTGGCGATGC
2221	TGTCGGAATG	GACGATATCC	CGCAAGAGGC	CCGGCAGTAC	CGGCATAACC	AAGCCTATGC
2281	CTACAGCATC	CAGGGTGACG	GTGCCGAGGA	TGACGATGAG	CGCATTGTTA	GATTTTCATAC
2341	ACGGTGCCCTG	ACTGCGTTAG	CAATTTAACT	GTGATAAACT	ACCGCATTAA	AGCTTATCGA
2401	TGATAAGCTG	TCAAACATGA	GAATTCTTGA	AGACGAAAGG	GCCTCGTGAT	ACGCCTATTT
2461	TTATAGGTTA	ATGTCAATGAT	AATAATGGTT	TCTTAGACGT	CAGGTGGCAC	TTTTCGGGGA
2521	AATGTGCGCG	GAACCCCTAT	TTGTTTATTT	TTCTAAATAC	ATTCAAATAT	GTATCCGCTC
2581	ATGAGACAAT	AACCCGTGATA	AATGCTTCAA	TAATATTGAA	AAAGGAAGAG	TATGAGTATT
2641	CAACATTTCC	GTGTCGCCCT	TATTCCTTTT	TTTGCGGCAT	TTTGCCCTTC	TGTTTTTGCT
2701	CACCCAGAAA	CGCTGGTGAA	AGTAAAAGAT	GCTGAAGATC	AGTTGGGTGC	ACGAGTGGGT

Figure 34B

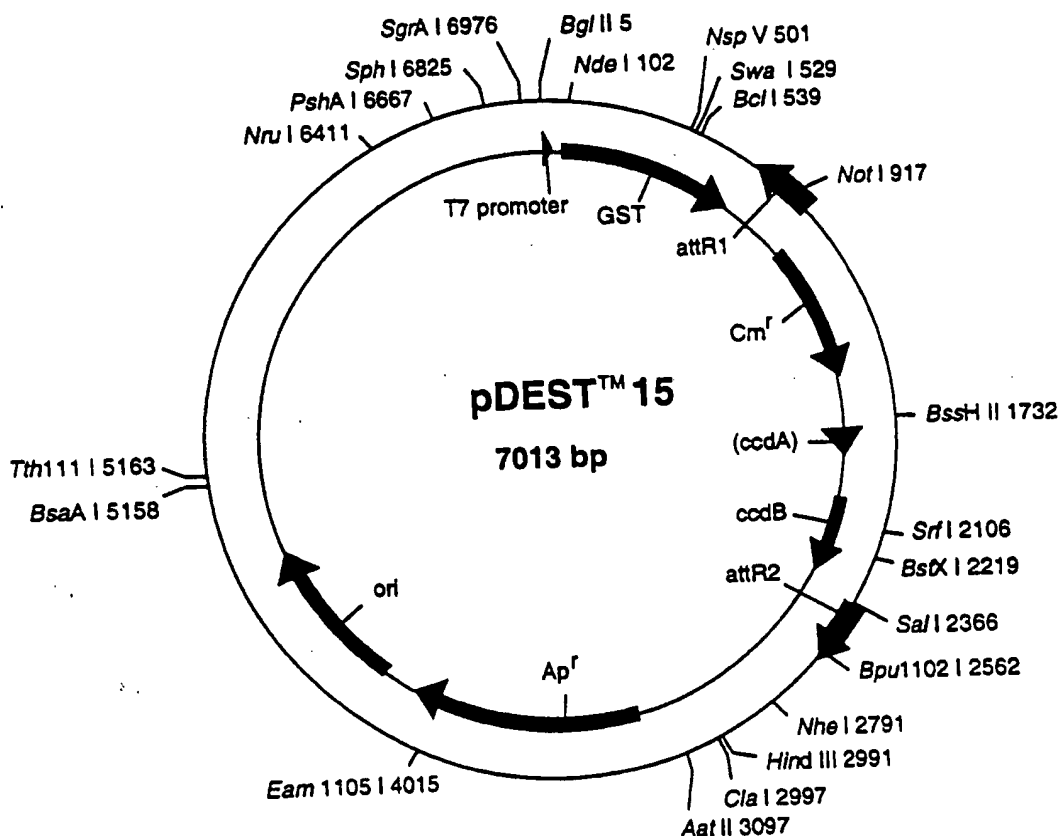
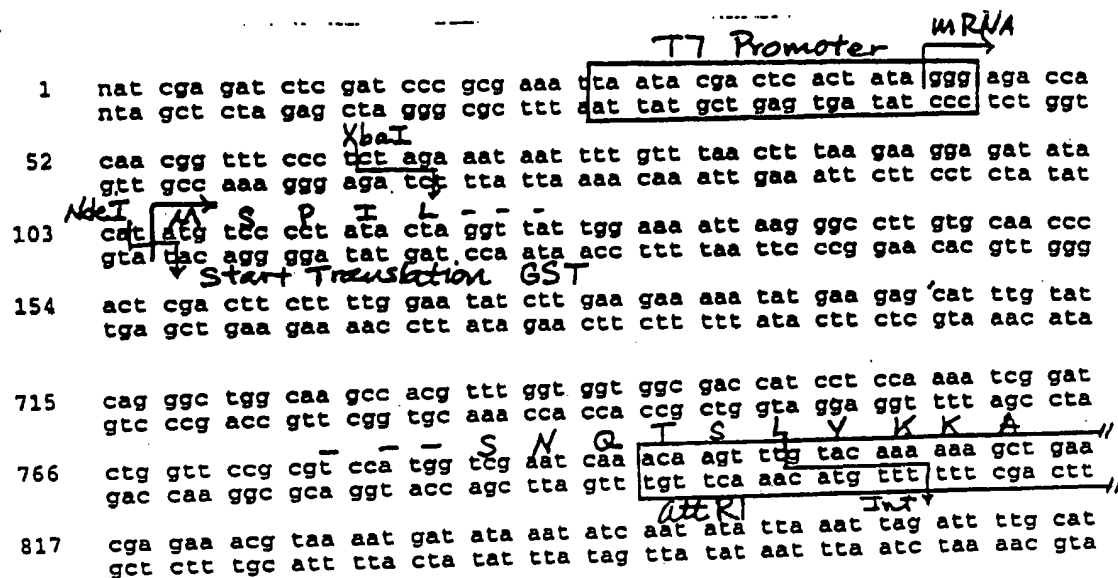
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2821 TTTCCAATGA TGAGCACTTT TAAAGTTCTG CTATGTGGCG CGGTATTATC CCGTGTTGAC
2881 GCCGGGCAAG AGCAACTCGG TCGCCGCATA CACTATTCTC AGAATGACTT GGTGAGTAC
2941 TCACCAGTCA CAGAAAAGCA TCTTACGGAT GGCATGACAG TAAGAGAATT ATGCAGTGCT
3001 GCCATAACCA TGAGTGATAA CACTGCGGCC AACTTACTTC TGACAACGAT CGGAGGACCG
3061 AAGGAGCTAA CCGCTTTTTT GCACAACATG GGGGATCATG TAACTCGCCT TGATCGTTGG
3121 GAACCGGAGC TGAATGAAGC CATACCAAAC GACGAGCGTG ACACCACGAT GCCTGCAGCA
3181 ATGGCAACAA CGTTGCGCAA ACTATTAACT GGCGAACTAC TTACTCTAGC TTCCCGGCAA
3241 CAATTAATAG ACTGGATGGA GCGGATAAAA GTTGCAGGAC CACTTCTGCG CTCGGCCCTT
3301 CCGGCTGGCT GGTATTATTG TGATAAATCT GGAGCCGGTG AGCGTGGGTC TCGCGGTATC
3361 ATTGCAGCAC TGGGGCCAGA TGGTAAGCCC TCCCGTATCG TAGTTATCTA CACGACGGGG
3421 AGTCAGGCAA CTATGGATGA ACGAAATAGA CAGATCGCTG AGATAGGTGC CTCACTGATT
3481 AAGCATTGGT AACTGTCAGA CCAAGTTTAC TCATATATAC TTTAGATTGA TTTAAAACTT
3541 CATTTTAAAT TTAAGGAT CTAGGTGAAG ATCCTTTTGT ATAATCTCAT GACCAAAATC
3601 CCTAACGTG AGTTTTCGTT CCACTGAGCG TCAGACCCCG TAGAAAAGAT CAAAGGATCT
3661 TCTTGAGATC CTTTTTTTCT GCGCGTAATC TGCTGCTTGC AAACAAAAAA ACCACCGCTA
3721 CCAGCGGTGG TTTGTTTGCC GGATCAAGAG CTACCAACTC TTTTCCGAA GGTAACTGGC
3781 TTCAGCAGAG CGCAGATACC AAATACTGTC CTTCTAGTGT AGCCGTAGTT AGGCCACCAC
3841 TTCAAGAACT CTGTAGCACC GCCTACATAC CTCGCTCTGC TAATCCTGTT ACCAGTGGCT
3901 GCTGCCAGTG GCGATAAGTC GTGTCTTACC GGGTTGGACT CAAGACGATA GTTACCGGAT
3961 AAGGCGCAGC GGTGCGGCTG AACGGGGGGT TCGTGACAC AGCCAGCTT GGAGCGAACG
4021 ACCTACACCG AACTGAGATA CCTACAGCGT GAGCTATGAG AAAGCGCCAC GCTTCCCGAA
4081 GGGAGAAAGG CGGACAGGTA TCCGGTAAGC GGCAGGGTCG GAACAGGAGA GCGCACGAGG
4141 GAGCTTCCAG GGGGAAACGC CTGGTATCTT TATAGTCCTG TCGGGTTTCG CCACCTCTGA
4201 CTTGAGCGTC GATTTTGTG ATGCTCGTCA GGGGGGCGGA GCCTATGGAA AAACGCCAGC
4261 AACGCGCCT TTTTACGGTT CCTGGCCTTT TGCTGGCCTT TTGCTCACAT GTTCTTTCCT
4321 GCGTTATCCC CTGATTCTGT GGATAACCGT ATTACCGCCT TTGAGTGAGC TGATACCGCT
4381 CGCCGCAGCC GAACGACCGA GCGCAGCGAG TCAGTGAGCG AGGAAGCGGA AGAGCGCCTG
4441 ATGCGGTATT TTCTCCTTAC GCATCTGTGC GGTATTTTAC ACCGCATATA TGGTGCATC
4501 TCAGTACAAT CTGCTCTGAT GCCGCATAGT TAAGCCAGTA TACACTCCGC TATCGCTACG
4561 TGA CTGGGTC ATGGCTGCGC CCCGACACCC GCCAACACCC GCTGACGCGC CCTGACGGGC
4621 TTGTCTGCTC CCGGCATCCG CTTACAGACA AGCTGTGACC GTCTCCGGGA GCTGCATGTG
4681 TCAGAGGTTT TCACCGTCAT CACCGAAACG CGCGAGGCAG CTGCGGTAAA GCTCATCAGC
4741 GTGGTCGTGA AGCGATTAC AGATGTCTGC CTGTTTATCC GCGTCCAGCT CGTTGAGTTT
4801 CTCCAGAAGC GTTAATGTCT GGCTTCTGAT AAAGCGGGCC ATGTTAAGGG CGGTTTTTTC
4861 CTGTTTGGTC ACTGATGCCT CCGTGTAAGG GGGATTTCTG TTCATGGGGG TAATGATACC
4921 GATGAAACGA GAGAGGATGC TCACGATACG GGTACTGAT GATGAACATG CCCGGTTACT
4981 GGAAGCTTGT GAGGGTAAAC AACTGGCGGT ATGGAATGCG CGGGACCAGA GAAAAATCAC
5041 TCAGGGTCAA TGCCAGCGCT TCGTTAATAC AGATGTAGGT GTTCCACAGG GTAGCCAGCA
5101 GCATCCTGCG ATGCAGATCC GGAACATAAT GGTGCAGGGC GCTGACTTCC GCGTTTCCAG
5161 ACTTTACGAA ACACGGAAAC CGAAGACCAT TCATGTTGTT GCTCAGGTCG CAGACGTTTT
5221 GCAGCAGCAG TCGCTTACG TTCGCTCGCG TATCGGTGAT TCATTCTGCT AACCAGTAAG
5281 GCAACCCCGC CAGCCTAGCC GGGTCTCAA CGACAGGAGC ACGATCATGC GCACCCGTGG
5341 CCAGGACCCA ACGCTGCCCG AGATGCGCCG CGTGCGGCTG CTGGAGATGG CGGACGCGAT
5401 GGATATGTTT TGCCAAGGGT TGGTTTGCGC ATTACAGTT CTCCGCAAGA ATTGATTGGC
5461 TCCAATTCTT GGAGTGGTGA ATCCGTTAGC GAGGTGCCGC CGGCTTCCAT TCAGGTGAG
5521 GTGGCCCGGC TCCATGCACC GCGACGCAAC GCGGGGAGGC AGACAAGGTA TAGGGCGGCG
5581 CTTACAATCC ATGCCAACCC GTTCCATGTG CTCGCCGAGG CGGCATAAAT CGCCGTGACG
5641 ATCAGCGTGC CAGTGATCGA AGTTAGGCTG GTAAGAGCCG CGAGCGATCC TTGAAGCTGT
5701 CCCTGATGGT CGTCATCTAC CTGCCTGGAC AGCATGGCCT GCAACGCGGG CATCCCGATG
5761 CCGCCGGAAG CGAGAAGAAT CATAATGGGG AAGGCCATCC AGCCTCGCGT CGCGAACGCC
5821 AGCAAGACGT AGCCAGCGC GTCGGCCGCC ATGCCGGCGA TAATGGCCTG CTTCTCGCCG
5881 AAACGTTTTG TGGCGGGACC AGTGACGAAG GCTTGAGCGA GGGCGTGCAA GATTCCGAAT
5941 ACCGCAAGCG ACAGGCCGAT CATCGTCGCG CTCCAGCGAA AGCGGTCTCT GCCGAAAATG
6001 ACCCAGAGCG CTGCCGGCAC CTGTCCTACG AGTTGCATGA TAAAGAAGAC AGTCATAAGT
6061 GCGGCGACGA TAGTCATGCC CCGCGCCAC CGGAAGGAGC TGA CTGGGTT GAAGGCTCTC
6121 AAGGGCATCG GTCGATCGAC GCTCTCCCTT ATGCGACTCC TGCATTAGGA AGCAGCCAG
6181 TAGTAGGTTG AGGCCGTTGA GCACCGCCGC CGCAAGGAAT GGTGCATGCA AGGAGATGGC-

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6241 GCCCAACAGT CCCCCGGCCA CGGGGCCTGC CACCATACCC ACGCCGAAAC AAGCGCTCAT
6301 GAGCCCGAAG TGGCGAGCCC GATCTTCCCC ATCGGTGATG TCGGCGATAT AGGCGCCAGC
6361 AACCGCACCT GTGGCGCCGG TGATGCCGGC CACGATGCGT CCGGCGTAGA GGATCGAGAT
6421 CT

FIGURE 34D

Figure 35A: pDEST15 Glutathione-S-transferase Fusion in *E. coli*, T7 Promoter



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pDEST15 7013 bp

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
108..776	GST
916..792	attR1
1025..1537	CmR
1804..1888	inactivated ccdA
2026..2331	ccdB
2372..2496	attR2
3233..4093	ampR

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1  ATCGAGATCT CGATCCCGCG AAATTAATAC GACTCACTAT AGGGAGACCA CAACGGTTTC
61 CCTCTAGAAA TAATTTTGT TAACTTTAAG AAGGAGATAT ACATATGTCC CCTATACTAG
121 GTTATTGGAA AATTAAGGGC CTTGTGCAAC CCACTCGACT TCTTTTGGAA TATCTTGAAG
181 AAAAAATATGA AGAGCATTTG TATGAGCGCG ATGAAGGTGA TAAATGGCGA AACAAAAAGT
241 TTGAATTGGG TTTGGAGTTT CCCAATCTTC CTTATTATAT TGATGGTGAT GTTAAATTAA
301 CACAGTCTAT GGCCATCATA CGTTATATAG CTGACAAGCA CAACATGTTG GGTGGTTGTC
361 CAAAAGAGCG TGCAGAGATT TCAATGCTTG AAGGAGCGGT TTTGGATATT AGATACGGTG
421 TTTCGAGAAT TGCATATAGT AAAGACTTTG AAACCTCTCA AGTTGATTTT CTTAGCAAGC
481 TACCTGAAAT GCTGAAAATG TTCGAAGATC GTTTATGTCA TAAAACATAT TTAAATGGTG
541 ATCATGTAAC CCATCCTGAC TTCATGTTGT ATGACGCTCT TGATGTTGTT TTATACATGG
601 ACCCAATGTG CCTGGATGCG TTCCCAAAAT TAGTTTGTTC TAAAAACGCT ATTGAAGCTA
661 TCCCACAAAT TGATAAGTAC TTGAAATCCA GCAAGTATAT AGCATGGCCT TTGCAGGGCT
721 GGCAAGCCAC GTTTGGTGGT GGCAGCCATC CTCCAAAATC GGATCTGGTT CCGCGTCCAT
781 GGTGCAATCA AACAAAGTTT TACAAAAAAG CTGAACGAGA AACGTAAAT GATATAAATA
841 TCAATATATT AAATTAGATT TTGCATAAAA AACAGACTAC ATAATACTGT AAAACACAAC
901 ATATCCAGTC ACTATGGCGG CCGCATTAGG CACCCAGGC TTTACACTTT ATGCTTCCGG
961 CTCGTATAAT GTGTGGATTT TGAGTTAGGA TCCGTCGAGA TTTTCAGGAG CTAAGGAAGC
1021 TAAAATGGAG AAAAAAATCA CTGGATATAC CACCGTTGAT ATATCCCAAT GGCATCGTAA
1081 AGAACAATTT GAGGCATTTT AGTCAGTTGC TCAATGTACC TATAACCAGA CCGTTCAGCT
1141 GGATATTACG GCCTTTTAA AGACCGTAAA GAAAAATAAG CACAAGTTT ATCCGCGCTT
1201 TATTCACATT CTTGCCCGCC TGATGAATGC TCATCCGGAA TTCCGTATGG CAATGAAAGA
1261 CGGTGAGCTG GTGATATGGG ATAGTGTTCA CCCTTGTTAC ACCGTTTCC ATGAGCAAAC
1321 TGAAACGTTT TCATCGCTCT GGAGTGAATA CCACGACGAT TTCCGGCAGT TTCTACACAT
1381 ATATTCGCAA GATGTGGCGT GTTACGGTGA AAACCTGGCC TATTTCCCTA AAGGGTTTAT
1441 TGAGAATATG TTTTTCGTCT CAGCCAATCC CTGGGTGAGT TTCACCAGT TTGATTTAAA
1501 CGTGGCCAAT ATGGACAAC TCTTCGCCCC CGTTTTCACC ATGGGCAAAT ATTATACCCA
1561 AGGCGACAAG GTGCTGATGC CGCTGGCGAT TCAGGTTTCA CATGCCGTCT GTGATGGCTT
1621 CCATGTGGCG AGAATGCTTA ATGAATTACA ACAGTACTGC GATGAGTGGC AGGGCGGGGC
1681 GTAATCTAGA GGATCCGGCT TACTAAAAGC CAGATAACAG TATGCGTATT TGC CGCTGA
1741 TTTTTCGGT ATAAGAATAT ATACTGATAT GTATACCCGA AGTATGTCAA AAAGAGTGTT
1801 GCTATGAAGC AGCGTATTAC AGTGACAGTT GACAGCGACA GCTATCAGTT GCTCAAGGCA
1861 TATATGATGT CAATATCTCC GGTCTGGTAA GCACAACCAT GCAGAATGAA GCCCGTCGTC
1921 TCGCTGCCGA ACGCTGGAAA GCGGAAAATC AGGAAGGGAT GGCTGAGGTC GCCCGGTTTA
1981 TTGAAATGAA CGGCTCTTTT GCTGACGAGA ACAGGGACTG GTGAAATGCA GTTTAAGGTT
2041 TACACCTATA AAAGAGAGAG CCGTTATCGT CTGTTTGTGG ATGTACAGAG TGATATTATT
2101 GACACGCCCG GGCGACGGAT GGTGATCCCC CTGGCCAGTG CACGTCTGCT GTCAGATAAA
2161 GTCTCCCGTG AACTTTACCC GGTGGTGCAT ATCGGGGATG AAAGCTGGCG CATGATGACC
2221 ACCGATATGG CCAGTGTGCC GGTCTCCGTT ATCGGGGAAG AAGTGGCTGA TCTCAGCCAC
2281 CGCGAAAATG ACATCAAAA CGCCATTAA CTGATGTTCT GGGGAATATA AATGTCAGGC
2341 TCCCTTATAC ACAGCCAGTC TGCAGGTCGA CCATAGTGAC TGGATATGTT GTGTTTACA
2401 GTATTATGTA GTCTGTTTTT TATGCAAAAT CTAATTTAAT ATATTGATAT TTATATCATT
2461 TTACGTTTCT CGTTCAGCTT TCTGTACAA AGTGGTTTGA TTCGACCCGG GATCCGGCTG
2521 CTAACAAAGC CCGAAAGGAA GCTGAGTTGG CTGCTGCCAC CGCTGAGCAA TAACTAGCAT
2581 AACCCCTTGG GGCCTCTAAA CGGGTCTTGA GGGGTTTTTT GCTGAAAGGA GGAACATAT
2641 CCGGATATCC ACAGGACGGG TGTGGTCGCC ATGATCGCGT AGTCGATAGT GGCTCCAAGT-

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FIGURE 35B

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2701 AGCGAAGCGA GCAGGACTGG GCGGCGGCCA AAGCGGTCCG ACAGTGCTCC GAGAACGGGT
2761 GCGCATAGAA ATTGCATCAA CGCATATAGC GCTAGCAGCA CGCCATAGTG ACTGGCGATG
2821 CTGTCCGAAT GGACGATATC CCGCAAGAGG CCCGGCAGTA CCGGCATAAC CAAGCCTATG
2881 CCTACAGCAT CCAGGGTGAC GGTGCCGAGG ATGACGATGA GCGCATTGTT AGATTTTCATA
2941 CACGGTGCTT GACTGCGTTA GCAATTAAAC TGTGATAAAC TACCGCATT AAGCTTATCG
3001 ATGATAAGCT GTCAAACATG AGAATTCTTG AAGACGAAAG GGCCTCGTGA TACGCCTATT
3061 TTTATAGGTT AATGTCATGA TAATAATGGT TTCTTAGACG TCAGGTGGCA CTTTTCGGGG
3121 AAATGTGCGC GGAACCCCTA TTTGTTTATT TTTCTAAATA CATTCAAATA TGTATCCGCT
3181 CATGAGACAA TAACCCTGAT AAATGCTTCA ATAATATTGA AAAAGGAAGA GTATGAGTAT
3241 TCAACATTTT CGTGTGCGCC TTATTCCCTT TTTTGCGGCA TTTTGCCTTC CTGTTTTTGC
3301 TCACCCAGAA ACGCTGGTGA AAGTAAAGA TGCTGAAGAT CAGTTGGGTG CACGAGTGGG
3361 TTACATCGAA CTGGATCTCA ACAGCGGTAA GATCCTTGAG AGTTTTCGCC CCGAAGAACG
3421 TTTTCCAATG ATGAGCACTT TTAAAGTTCT GCTATGTGGC GCGGTATTAT CCCGTGTTGA
3481 CGCCGGGCAA GAGCAACTCG GTCGCCGAT ACACTATTCT CAGAATGACT TGGTTGAGTA
3541 CTCACCACTC ACAGAAAAGC ATCTTACGGA TGGCATGACA GTAAGAGAAT TATGCAGTGC
3601 TGCCATAACC ATGAGTGATA AACTGCGGC CAACTTACTT CTGACAACGA TCGGAGGACC
3661 GAAGGAGCTA ACCGCTTTTT TGCACAACAT GGGGGATCAT GTAACTCGCC TTGATCGTTG
3721 GGAACCGGAG CTGAATGAAG CCATACCAA CGACGAGCGT GACACCAGA TGCCTCGAGC
3781 AATGGCAACA ACGTTGCGCA AACTATTAACT TGGCGAACTA CTTACTCTAG CTTCCCGGCA
3841 ACAATTAAATA GACTGGATGG AGGCGGATAA AGTTGCAGGA CCACTTCTGC GCTCGGCCCT
3901 TCCGGCTGGC TGGTTTATTG CTGATAAATC TGGAGCCGGT GAGCGTGGGT CTCGCGGTAT
3961 CATTGCAGCA CTGGGGCCAG ATGGTAAGCC CTCCCGTATC GTAGTTATCT ACACGACGGG
4021 GAGTCAGGCA ACTATGGATG AACGAAATAG ACAGATCGCT GAGATAGGTG CCTCACTGAT
4081 TAAGCATTGG TAACTGTCAG ACCAAGTTTA CTCATATATA CTTTAGATTG ATTTAAAACT
4141 TCATTTTTAA TTTAAAAGGA TCTAGGTGAA GATCCTTTTT GATAATCTCA TGACCAAAAT
4201 CCCTTAACGT GAGTTTTTCGT TCCACTGAGC GTCAGACCCC GTAGAAAAGA TCAAAGGATC
4261 TTCTTGAGAT CCTTTTTTTC TGCGCGTAAT CTGCTGCTTG CAAACAAAAA AACCACCGCT
4321 ACCAGCGGTG GTTTGTTTGC CGGATCAAGA GCTACCAACT CTTTTCCGA AGGTAACCTG
4381 CTTCCAGAGA GCGCAGATAC CAAATACTGT CTTCTAGTG TAGCCGTAGT TAGGCCACCA
4441 CTTCAAGAAC TCTGTAGCAC CGCCTACATA CCTCGCTCTG CTAATCCTGT TACCAGTGGC
4501 TGCTGCCAGT GCGGATAAGT CGTGCTTAC CGGGTTGGAC TCAAGAAGAT AGTTACCGGA
4561 TAAGGCGCAG CGGTGCGGCT GAACGGGGGG TTCGTGCACA CAGCCCAGCT TGGAGCGAAC
4621 GACCTACACC GAACTGAGAT ACCTACAGCG TGAGCTATGA GAAAGCGCCA CGCTTCCCGA
4681 AGGGAGAAAG GCGGACAGGT ATCCGGTAAG CGGCAGGGTC GGAACAGGAG AGCGCACGAG
4741 GGAGCTTCCA GGGGGAAACG CCTGGTATCT TTATAGTCCT GTCGGGTTTC GCCACCTCTG
4801 ACTTGAGCGT CGATTTTTGT GATGCTCGTC AGGGGGGGCG AGCCTATGGA AAAACGCCAG
4861 CAACGCGGCC TTTTACGGT TCCTGGCCTT TTGCTGGCCT TTTGCTCACA TGTTCTTTCC
4921 TGCGTTATCC CCTGATTCTG TGGATAACCG TATTACCGCC TTTGAGTGAG CTGATACCGC
4981 TCGCCGCAGC CGAACGACCG AGCGCAGCGC GTCAGTGAGC GAGGAAGCGG AAGAGCGCCT
5041 GATGCGGTAT TTTCTCCTTA CGCATCTGTG CGGTATTTCA CACCGCATAT ATGGTGCACT
5101 CTCAGTACAA TCTGCTCTGA TGCCGCATAG TTAAGCCAGT ATACACTCCG CTATCGCTAC
5161 GTGACTGGGT CATGGCTGCG CCCCACACC CGCCAACACC CGCTGACGCG CCCTGACGGG
5221 CTTGTCTGCT CCCGGCATCC GCTTACAGAC AAGCTGTGAC CGTCTCCGGG AGCTGCATGT
5281 GTCAGAGGTT TTCACCGTCA TCACCGAAAC GCGCGAGGCA GCTGCGGTAA AGCTCATCAG
5341 CGTGGTCTGT AAGCGATTCA CAGATGTCTG CCTGTTTCATC CGCGTCCAGC TCGTTGAGTT
5401 TCTCCAGAAG CGTTAATGTC TGGCTTCTGA TAAAGCGGGC CATGTTAAGG GCGGTTTTTT
5461 CCTGTTTGGT CACTGATGCC TCCGTGTAAG GGGGATTTCT GTTCATGGGG GTAATGATAC
5521 CGATGAAACG AGAGAGGATG CTCACGATAC GGGTTACTGA TGATGAACAT GCCCGGTTAC
5581 TGGAACTGTT TGAGGGTAAA CAACTGGCGG TATGGATGCG GCGGGACCAG AGAAAAATCA
5641 CTCAGGGTCA ATGCCAGCGC TTCGTTAATA CAGATGTAGG TGTCCACAG GGTAGCCAGC
5701 AGCATCCTGC GATGCAGATC CGGAACATAA TGGTGCAGGG CGCTGACTTC CGCGTTTCCA
5761 GACTTTACGA AACACGGAAC CCGAAGACCA TTCATGTTGT TGCTCAGGTC GCAGACGTTT
5821 TGCAGCAGCA GTCGCTTAC GTTCGCTCGC GTATCGGTGA TTCATTCTGC TAACCAGTAA
5881 GGCAACCCCG CCAGCCTAGC CGGGTCCTCA ACGACAGGAG CACGATCATG CGCACCCTGT
5941 GCCAGGACCC AACGCTGCCC GAGATGCGCC GCGTGCGGCT GCTGGAGATG GCGGACCGGA
6001 TGGATATGTT CTGCCAAGGG TTGGTTTGCG CATTCACAGT TCTCCGCAAG AATTGATTGG
6061 CTCCAATTCT TGGAGTGGTG AATCCGTTAG CGAGGTGCCG CCGGCTTCCA TTCAGTCCGA
6121 GGTGGCCCCG CTCCATGCAC CGCGACGCAA CGCGGGGAGG CAGACAAGGT ATAGGGCGGC-

FIGURE 35C

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6181 GCCTACAATC CATGCCAACC CGTTCCATGT GCTCGCCGAG GCGGCATAAA TCGCCGTGAC
6241 GATCAGCGGT CCAGTGATCG AAGTTAGGCT GGTAAGAGCC GCGAGCGATC CTTGAAGCTG
6301 TCCCTGATGG TCGTCATCTA CCTGCCTGGA CAGCATGGCC TGCAACGCGG GCATCCCGAT
6361 GCCGCCGGAA GCGAGAAGAA TCATAATGGG GAAGGCCATC CAGCCTCGCG TCGCGAACGC
6421 CAGCAAGACG TAGCCCAGCG CGTCGCCCGC CATGCCGGCG ATAATGGCCT GCTTCTCGCC
6481 GAAACGTTTG GTGGCGGGAC CAGTGACGAA GGCTTGAGCG AGGGCGTGCA AGATTCCGAA
6541 TACCGCAAGC GACAGGCCGA TCATCGTCGC GCTCCAGCGA AAGCGGTCCT CGCCGAAAA
6601 GACCCAGAGC GCTGCCGGCA CCTGTCCTAC GAGTTGCATG ATAAAGAAGA CAGTCATAAG
6661 TGCGGCGACG ATAGTCATGC CCCGCGCCCA CCGGAAGGAG CTGACTGGGT TGAAGGCTCT
6721 CAAGGGCATC GGTGATCGA CGCTCTCCCT TATGCGACTC CTGCATTAGG AAGCAGCCCA
6781 GTAGTAGGTT GAGGCCGTTG AGCACCGCCG CCGCAAGGAA TGGTGCATGC AAGGAGATGG
6841 CGCCCAACAG TCCCCCGGCC ACGGGGCCTG CCACCATACC CACGCCGAAA CAAGCGCTCA
6901 TGAGCCCGAA GTGGCGAGCC CGATCTTCCC CATCGGTGAT GTCGGCGATA TAGGCGCCAG
6961 CAACCGCACC TGTGGCGCCG GTGATGCCGG CCACGATGCG TCCGGCGTAG AGG

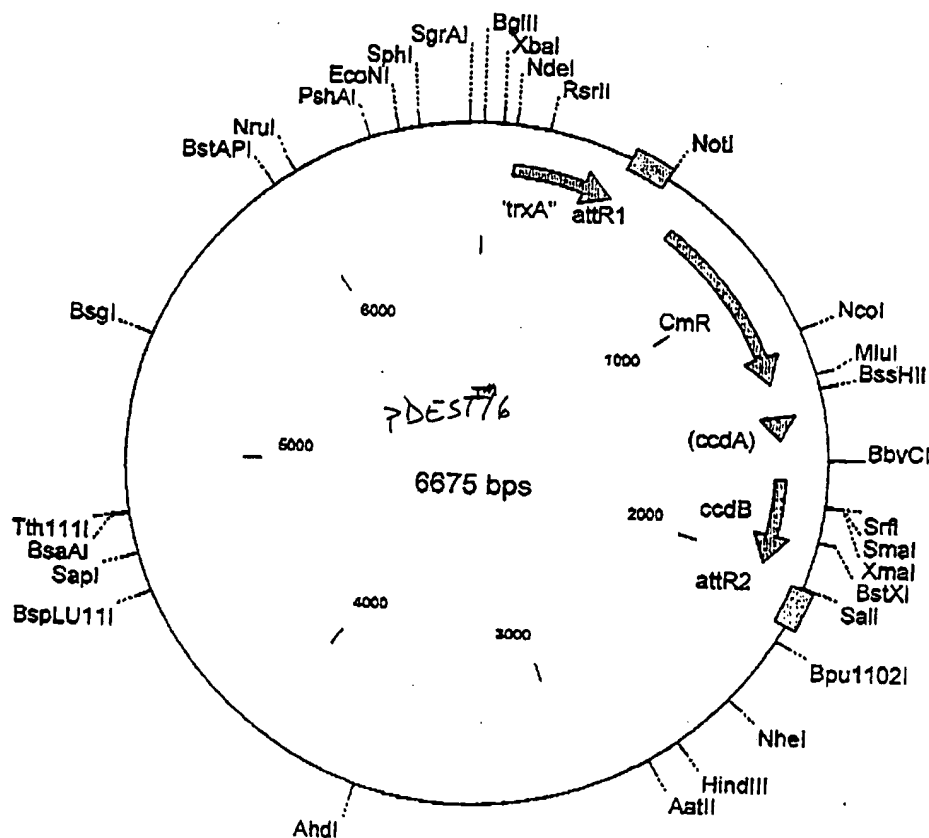
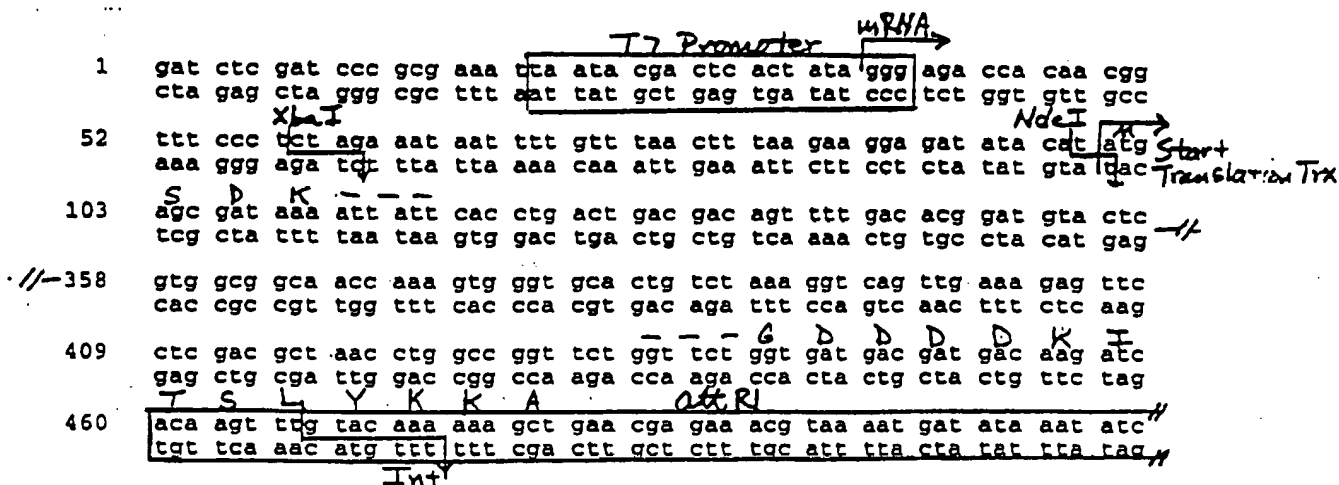
FIGURE 351)

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Figure 36A:

pDEST16

Thioredoxin N-Fusion Protein in E. coli with T7 Promoter



pDEST16 6675 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
104..457		trxA
585..461		attR1
694..1353		CmR
1473..1557		inactivated ccdA
1695..2000		ccdB
2041..2165		attR2

1	AGATCTCGAT	CCCGCGAAAT	TAATACGACT	CACTATAGGG	AGACCACAAC	GGTTTCCCTC
61	TAGAAATAAT	TTTGTTTAAC	TTTAAGAAGG	AGATATACAT	ATGAGCGATA	AAATTATTCA
121	CCTGACTGAC	GACAGTTTGT	ACACGGATGT	ACTCAAAGCG	GACGGGGCGA	TCCTCGTCGA
181	TTTCTGGGCA	GAGTGGTGCG	GTCCGTGCAA	AATGATCGCC	CCGATTCTGG	ATGAAATCGC
241	TGACGAATAT	CAGGGCAAAC	TGACCGTTGC	AAAACGAAC	ATCGATCAAA	ACCCTGGCAC
301	TGCGCCGAAA	TATGGCATCC	GTGGTATCCC	GACTCTGCTG	CTGTTCAAAA	ACGGTGAAGT
361	GGCGGCAACC	AAAGTGGGTG	CACTGTCTAA	AGGTCAGTTG	AAAGAGTTCC	TCGACGCTAA
421	CCTGGCCGGT	TCTGGTTCTG	GTGATGACGA	TGACAAGATC	ACAAGTTTGT	ACAAAAAAGC
481	TGAACGAGAA	ACGTAAAATG	ATATAAATAT	CAATATATTA	AATTAGATTT	TGCATAAAAA
541	ACAGACTACA	TAATACTGTA	AAACACAACA	TATCCAGTCA	CTATGGCGGC	CGCATTAGGC
601	ACCCAGGCT	TTACACTTTA	TGCTTCCGGC	TCGTATAATG	TGTGGATTTT	GAGTTAGGAT
661	CCGGCGAGAT	TTTCAGGAGC	TAAGGAAGCT	AAAATGGAGA	AAAAAATCAC	TGGATATACC
721	ACCGTTGATA	TATCCCAATG	GCATCGTAAA	GAACATTTTG	AGGCATTTCA	GTCAGTTGCT
781	CAATGTACCT	ATAACCAGAC	CGTTCAGCTG	GATATTACGG	CCTTTTAA	GACCGTAAAG
841	AAAAATAAGC	ACAAGTTTTA	TCCGGCCTTT	ATTCACATTC	TTGCCCGCCT	GATGAATGCT
901	CATCCGGAAT	TCCGTATGGC	AATGAAAGAC	GGTGAGCTGG	TGATATGGGA	TAGTGTTTAC
961	CCTTGTTACA	CCGTTTTCCA	TGAGCAAAC	GAAACGTTTT	CATCGCTCTG	GAGTGAATAC
1021	CACGACGATT	TCCGGCAGTT	TCTACACATA	TATTCGCAAG	ATGTGGCGTG	TTACGGTGAA
1081	AACCTGGCCT	ATTTCCCTAA	AGGGTTTATT	GAGAATATGT	TTTTCGTCTC	AGCCAATCCC
1141	TGGGTGAGTT	TCACCAGTTT	TGATTTACAA	GTGGCCAATA	TGGACAACCT	CTTCGCCCCC
1201	GTTTTACCCA	TGGGCAAATA	TTATACGCAA	GGCGACAAGG	TGCTGATGCC	GCTGGCGATT
1261	CAGGTTTCATC	ATGCCGCTCTG	TGATGGCTTC	CATGTCGGCA	GAATGCTTAA	TGAATTACAA
1321	CAGTACTGCG	ATGAGTGGCA	GGGCGGGGCG	TAAACGCGTG	GATCCGGCTT	ACTAAAAGCC
1381	AGATAACAGT	ATGCGTATTT	GCGCGCTGAT	TTTTGCGGTA	TAAGAATATA	TACTGATATG
1441	TATACCCGAA	GTATGTCAAA	AAGAGGTGTG	CTATGAAGCA	GCGTATTACA	GTGACAGTTG
1501	ACAGCGACAG	CTATCAGTTG	CTCAAGGCAT	ATATGATGTC	AATATCTCCG	GTCTGGTAAG
1561	CACAACCATG	CAGAATGAAG	CCCGTCTGCT	CGGTGCCGAA	CGCTGGAAAG	CGGAAATCA
1621	GGAAGGGATG	GCTGAGGTCG	CCCGGTTTAT	TGAAATGAAC	GGCTCTTTTG	CTGACGAGAA
1681	CAGGGACTGG	TGAAATGCAG	TTTAAGGTTT	ACACCTATAA	AAGAGAGAGC	CCTTATCGTC
1741	TGTTTGTGGA	TGTACAGAGT	GATATTATTG	ACACGCCCCG	GCGACGGATG	GTGATCCCCC
1801	TGGCCAGTGC	ACGTCCTGCTG	TCAGATAAAG	TCTCCCGTGA	ACTTTACCCG	GTGGTGCATA
1861	TCGGGGATGA	AAGCTGGCGC	ATGATGACCA	CCGATATGGC	CAGTGTGCCG	GTCTCCGTTA
1921	TCGGGGAAGA	AGTGGCTGAT	CTCAGCCACC	GCGAAAATGA	CATCAAAAAC	GCCATTAACC
1981	TGATGTTCTG	GGGAATATAA	ATGTCAGGCT	CCCTTATACA	CAGCCAGTCT	GCAGGTCGAC
2041	CATAGTGACT	GGATATGTTG	TGTTTTACAG	TATTATGTAG	TCTGTTTTTT	ATGCAAAATC
2101	TAATTTAATA	TATTGATATT	TATATCATTT	TACGTTTCTC	GTTTCAGCTT	CTTGTAACAA
2161	GTGGTGATGA	TCCGGCTGCT	AACAAAGCCC	GAAAGGAAGC	TGAGTTGGCT	GCTGCCACCG
2221	CTGAGCAATA	ACTAGCATAA	CCCCTTGGGG	CCTCTAAACG	GGTCTTGAGG	GGTTTTTTTG
2281	TGAAAGGAGG	AACTATATCC	GGATATCCAC	AGGACGGGTG	TGGTCGCCAT	GATCGCGTAG
2341	TCGATAGTGG	CTCCAAGTAG	CGAAGCGAGC	AGGACTGGGC	GGCGGCCAAA	GCGGTCCGGAC
2401	AGTGCTCCGA	GAACGGGTGC	GCATAGAAAT	TGCATCAACG	CATATAGCGC	TAGCAGCACG
2461	CCATAGTGAC	TGGCGATGCT	GTCGGAATGG	ACGATATCCC	GCAAGAGGCC	CGGCAGTACC
2521	GGCATAACCA	AGCCTATGCC	TACAGCATCC	AGGGTGACGG	TGCCGAGGAT	GACGATGAGC
2581	GCATTGTTAG	ATTTTCATACA	CGGTGCCTGA	CTGCGTTAGC	AATTTAACTG	TGATAAACTA
2641	CCGCATTAAA	GCTTATCGAT	GATAAGCTGT	CAAACATGAG	AATTCTTGAA	GACGAAAGGG
2701	CCTCGTGATA	CGCCTATTTT	TATAGGTTAA	TGTCATGATA	ATAATGGTTT	CTTAGACGTC
2761	AGGTGGCACT	TTTCGGGGAA	ATGTGCGCGG	AACCCCTATT	TGTTTATTTT	TCTAAATACA-

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2821 TTCAAATATG TATCCGCTCA TGAGACAATA ACCCTGATAA ATGCTTCAAT AATATTGAAA
 2881 AAGGAAGAGT ATGAGTATTC AACATTTCCTG TGTGCGCCCTT ATTCCCTTTT TTGCGGCATT
 2941 TTGCCTTCCT GTTTTTGCTC ACCCAGAAAC GCTGGTGAAA GTAAAAGATG CTGAAGATCA
 3001 GTTGGGTGCA CGAGTGGGT ACATCGAACT GGATCTCAAC AGCGGTAAGA TCCTTGAGAG
 3061 TTTTCGCCCC GAAGAACGTT TTCCAATGAT GAGCACTTTT AAAGTTCTGC TATGTGGCGC
 3121 GGTATTATCC CGTGTGACG CCGGGCAAGA GCAACTCGGT CGCCGCATAC ACTATTCTCA
 3181 GAATGACTTG GTTGAGTACT CACCAGTCAC AGAAAAGCAT CTTACGGATG GCATGACAGT
 3241 AAGAGAATTA TGCAGTGCTG CCATAACCAT GAGTGATAAC ACTGCGGCCA ACTTACTTCT
 3301 GACAACGATC GGAGGACCGA AGGAGCTAAC CGCTTTTTTG CACAACATGG GGGATCATGT
 3361 AACTCGCCTT GATCGTTGGG AACCAGAGCT GAATGAAGCC ATACCAAACG ACGAGCGTGA
 3421 CACCACGATG CCTGCAGCAA TGGCAACAAC GTTGCACAAA CTATTAACCTG GCGAAGTACT
 3481 TACTCTAGCT TCCCGGCAAC AATTAATAGA CTGGATGGAG GCGGATAAAG TTGCAGGACC
 3541 ACTTCTGCGC TCGGCCCTTC CGGCTGGCTG GTTTATTGCT GATAAATCTG GAGCCGGTGA
 3601 GCGTGGGTCT CGCGGTATCA TTGCAGCACT GGGGCCAGAT GGTAAGCCCT CCCGTATCGT
 3661 AGTTATCTAC ACGACGGGGA GTCAGGCAAC TATGGATGAA CGAAATAGAC AGATCGCTGA
 3721 GATAGGTGCC TCACTGATTA AGCATTGGTA ACTGTCAGAC CAAGTTTACT CATATATACT
 3781 TTAGATTGAT TTAACCTTC ATTTTAAATT TAAAAGGATC TAGGTGAAGA TCCTTTTTGA
 3841 TAATCTCATG ACCAAAATCC CTTAACGTGA GTTTTCGTTT CACTGAGCGT CAGACCCCGT
 3901 AGAAAAGATC AAAGGATCTT CTTGAGATCC TTTTCTCTG CGCGTAATCT GCTGCTTGCA
 3961 AACAAAAAAA CCACCGCTAC CAGCGGTGGT TTGTTTGCCG GATCAAGAGC TACCAACTCT
 4021 TTTTCCGAAG GTAACCTGGT TCAGCAGAGC GCAGATACCA AATACTGTCC TTCTAGTGTA
 4081 GCCGTAGTTA GGCCACCACT TCAAGAACTC TGTAGCACCG CCTACATACC TCGCTCTGCT
 4141 AATCCTGTTA CCAGTGGCTG CTGCCAGTGG CGATAAGTCG TGTCTTACCG GGTGACTC
 4201 AAGACGATAG TTACCGGATA AGGCGCAGCG GTCGGGCTGA ACGGGGGGTT CGTGCACACA
 4261 GCCCAGCTTG GAGCGAACGA CCTACACCGA ACTGAGATAC CTACAGCGTG AGCTATGAGA
 4321 AAGCGCCACG CTTCCTGAAG GGAGAAAGGC GGACAGGTAT CCGGTAAGCG GCAGGGTCGG
 4381 AACAGGAGAG CGCACGAGGG AGCTTCAGG GGGAAACGCC TGGTATCTTT ATAGTCCTGT
 4441 CGGTTTCGAC CACCTCTGAC TTGAGCGTGG ATTTTGTGA TGCTCGTCAG GGGGGCGGAG
 4501 CCTATGGAAA AACGCCAGCA ACGCGCCCTT TTTACGGTTC CTGGCCTTTT GCTGGCCTTT
 4561 TGCTCACATG TTCTTCTCTG CGTTATCCCC TGATTCTGTG GATAACCGTA TTACCGCCTT
 4621 TGAGTGAGCT GATACCGCTC GCCGCAGCCG AACGACCGAG CGCAGCGAGT CAGTGACCGA
 4681 GGAAGCGGAA GAGCGCCTGA TGCGGTATTT TCTCCTTACG CATCTGTGCG GTATTTTACA
 4741 CCGCATATAT GGTGCACTCT CAGTACAATC TGCTCTGATG CCGCATAGTT AAGCCAGTAT
 4801 ACACTCCGCT ATCGCTACGT GACTGGGTCA TGGCTGCGCC CCGACACCCG CCAACACCCG
 4861 CTGACGCGCC CTGACGGGCT TGTCTGCTCC CGGCATCCGC TTACAGACAA GCTGTGACCG
 4921 TCTCCGGGAG CTGCATGTGT CAGAGGTTTT CACCGTCATC ACCGAAACGC GCGAGGCAGC
 4981 TGCGGTAAAG CTCATCAGCG TGGTCGTGAA GCGATTACCA GATGTCGTCC GTTTCATCCG
 5041 CGTCCAGCTC GTTGAGTTTC TCCAGAAGCG TTAATGTCTG GCTTCTGATA AAGCGGGCCA
 5101 TGTTAAGGCG GGTTTTTTCG TGTTTGGTCA CTGATGCCTC CGTGTAAAGG GGATTTCTGT
 5161 TCATGGGGGT AATGATACCG ATGAAACGAG AGAGGATGCT CACGATACGG GTTACTGATG
 5221 ATGAACATGC CCGGTTACTG GAACGTTGTG AGGTTAAACA ACTGGCGGTA TGGATGCGGC
 5281 GGGACCAGAG AAAAATCACT CAGGGTCAAT GCCAGCGCTT CGTTAATACA GATGTAGGTG
 5341 TTCCACAGGG TAGCCAGCAG CATCCTGCGA TGCAGATCCG GAACATAATG GTGCAGGGCG
 5401 CTGACTTCCG CGTTTCCAGA CTTTACGAAA CACGGAACCG GAAGACCATT CATGTTGTTG
 5461 CTCAGGTGCG AGACGTTTTG CAGCAGCAGT CGCTTCACGT TCGCTCGCGT ATCGGTGATT
 5521 CATTCTGCTA ACCAGTAAGG CAACCCCGCC AGCCTAGCCG GGTCCTCAAC GACAGGAGCA
 5581 CGATCATGCG CACCCGTGGC CAGGACCCAA CGCTGCCCGA GATGCGCCGC GTGCGGCTGC
 5641 TGGAGATGGC GGACGCGATG GATATGTTCT GCCAAGGGTT GGTTTGCGCA TTCACAGTTC
 5701 TCCGCAAGAA TTGATTGGCT CCAATTCTGT GAGTGGTGAA TCCGTTAGCG AGGTGCCGCC
 5761 GGCTTCCATT CAGGTCGAGG TGGCCCGCTT CCATGCACCG CGACGCAACG CCGGGAGGCA
 5821 GACAAGGTAT AGGGCGGCGC CTACAATCCA TGCCAACCCG TTCCATGTGC TCGCCGAGGC
 5881 GGCATAAATC GCCGTGACGA TCAGCGGTCC AGTGATCGAA GTTAGGCTGG TAAGAGCCGC
 5941 GAGCGATCCT TGAAGCTGTC CCTGATGGTC GTCATCTACC TGCTGGACA GCATGGCCTG
 6001 CAACGCGGGC ATCCCGATGC CGCCGGAAGC GAGAAGAATC ATAATGGGGA AGGCCATCCA
 6061 GCCTCGCGTC GCGAACGCCA GCAAGACGTA GCCCAGCGCG TCGGCCGCCA TGCCGGCGAT
 6121 AATGGCCTGC TTCTCGCCGA AACGTTTGGT GCGGGGACCA GTGACGAAGG CTTGAGCGAG
 6181 GCGGTGCAAG ATTCCGAATA CCGCAAGCGA CAGGCCGATC ATCGTCGCGC TCCAGCGAAA
 6241 GCGGTCTCTG CCGAAAATGA CCCAGAGCGC TGCCGGCACC TGTCTACGA GTTGCATGAT-

FIGURE 36C

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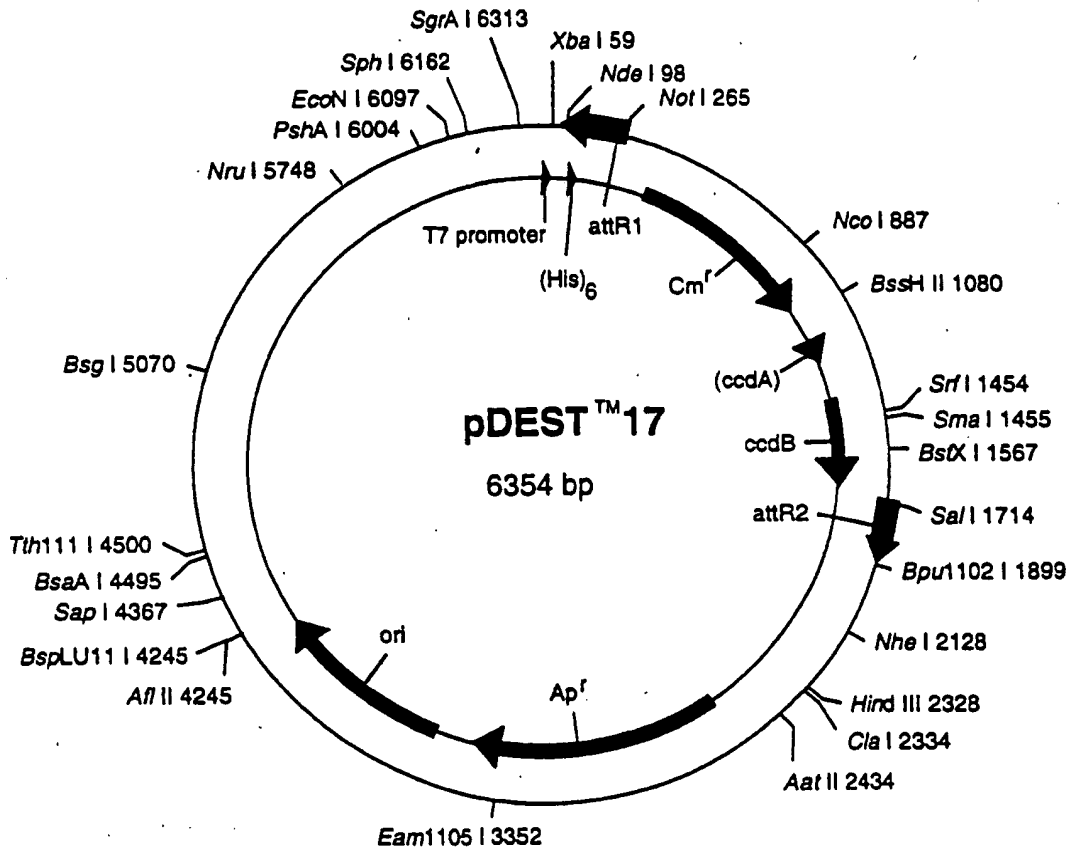
6301 AAAGAAGACA GTCATAAGTG CGGCGACGAT AGTCATGCCC CGCGCCCACC GGAAGGAGCT
6361 GACTGGGTTG AAGGCTCTCA AGGGCATCGG TCGATCGACG CTCTCCCTTA TGCGACTCCT
6421 GCATTAGGAA GCAGCCCAGT AGTAGGTTGA GGCCGTTGAG CACCGCCGCC GCAAGGAATG
6481 GTGCATGCAA GGAGATGGCG CCCAACAGTC CCCC GGCCAC GGGGCCTGCC ACCATACCCA
6541 CGCCGAAACA AGCGCTCATG AGCCCGAAGT GGCGAGCCCG ATCTTCCCCA TCGGTGATGT
6601 CGGCGATATA GGCGCCAGCA ACCGCACCTG TGGCGCCGGT GATGCCGGCC ACGATGCGTC
6661 CGGCGTAGAG GATCG

FIGURE 36D

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1 gat ccc gcg aaa tta ata cga ctc act ata ggg aga cca caa cgg ttt ccc
 cta ggg cgc ttt aat tat gct gag tga tat ccc tct ggt gtt gcc aaa ggg
 52 tct aga aat aat ttt gtt taa ctt taa gaa gga gat ata cat atg tgg tac
 aga tct tta tta aaa caa att gaa att ctt cct cta tat gta tac agc atg
 103 Y H H H H H L E S T S L Y K K A
 tac cat cac cat cac cat cac ctc gaa tca aca agt tgg tac aaa aaa gct
 atg gta gtg gta gtg gta gtg gag ctt agt tgt tca aac atg ttt ttt cga
 attR1 Int Y

T7 Promoter
 mRNA
 Start Translation



pDEST17 6354 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
258..134		attR1
367..1026		CmR
1146..1230		inactivated ccdA
1368..1673		ccdB
1714..1838		attR2
2564..3421		ampR
1	CGATCCCGCG AAATTAATAC GACTCACTAT AGGGAGACCA CAACGGTTTC CCTCTAGAAA	
61	TAATTTTGTT TAACTTTAAG AAGGAGATAT ACATATGTCG TACTACCATC ACCATCACCA	
121	TCACCTCGAA TCAACAAGTT TGTACAAAAA AGCTGAACGA GAAACGTAAA ATGATATAAA	
181	TATCAATATA TTAAATTAGA TTTTGCATAA AAAACAGACT ACATAATACT GTAAAACACA	
241	ACATATCCAG TCACTATGGC GGCCGCATTA GGCACCCAG GCTTTACACT TTATGCTTCC	
301	GGCTCGTATA ATGTGTGGAT TTTGAGTTAG GATCCGTCGA GATTTTCAGG AGCTAAGGAA	
361	GCTAAAATGG AGAAAAAAT CACTGGATAT ACCACCGTTG ATATATCCCA ATGGCATCGT	
421	AAAGAACATT TTGAGGCATT TCAGTCAGTT GCTCAATGTA CCTATAACCA GACCGTTCAG	
481	CTGGATATTA CGGCCTTTTT AAAGACCGTA AAGAAAAATA AGCACAAGTT TTATCCGGCC	
541	TTTATTACAA TTCTTGCCCG CCGTATGAAT GCTCATCCGG AATTCCGTAT GGCAATGAAA	
601	GACGGTGAGC TGGTGATATG GGATAGTGTT CACCCTTGTT ACACCGTTTT CCATGAGCAA	
661	ACTGAAACGT TTTCATCGCT CTGGAGTGAA TACCACGACG ATTTCCGGCA GTTCTACAC	
721	ATATATTTCG AAGATGTGGC GTGTTACGGT GAAAACCTGG CCTATTTCCC TAAAGGGTTT	
781	ATTGAGAATA TGTTTTTCGT CTCAGCCAAT CCCTGGGTGA GTTTCACCAG TTTTGATTTA	
841	AACGTGGCCA ATATGGACAA CTTCTTCGCC CCCGTTTTCA CCATGGGCAA ATATTATACG	
901	CAAGGCGACA AGGTGCTGAT GCCGCTGGCG ATTCAGGTTT ATCATGCCGT CTGTGATGGC	
961	TTCCATGTCG GCAGAATGCT TAATGAATTA CAACAGTACT GCGATGAGTG GCAGGGCGGG	
1021	GCGTAAAGAT CTGGATCCGG CTTACTAAAA GCCAGATAAC AGTATGCGTA TTTGCGCGCT	
1081	GATTTTTGCG GTATAAGAAT ATATACTGAT ATGTATACCC GAAGTATGTC AAAAAGAGGT	
1141	GTGCTATGAA GCAGCGTATT ACAGTGACAG TTGACAGCGA CAGCTATCAG TTGCTCAAGG	
1201	CATATATGAT GTCAATATCT CCGGTCTGGT AAGCACAACC ATGCAGAATG AAGCCCGTCG	
1261	TCTGCGTGCC GAACGCTGGA AAGCGGAAAA TCAGGAAGGG ATGGCTGAGG TCGCCCGGTT	
1321	TATTGAAATG AACGGCTCTT TTGCTGACGA GAACAGGGAC TGGTGAAATG CAGTTTAAGG	
1381	TTTACACCTA TAAAAGAGAG AGCCGTTATC GTCTGTTTGT GGATGTACAG AGTGATATTA	
1441	TTGACACGCC CGGGCGACGG ATGGTGATCC CCCTGGCCAG TGCACGTCTG CTGTCAGATA	
1501	AAGTCTCCCG TGAACCTTAC CCGGTGGTGC ATATCGGGGA TGAAGCTGG CGCATGATGA	
1561	CCACCGATAT GGCCAGTGTG CCGGTCTCCG TTATCGGGGA AGAAGTGGCT GATCTCAGCC	
1621	ACCGCGAAAA TGACATCAAA AACGCCATTA ACCTGATGTT CTGGGGAATA TAAATGTCAG	
1681	GCTCCCTTAT ACACAGCCAG TCTGCAGGTC GACCATAGTG ACTGGATATG TTGTGTTTTA	
1741	CAGTATTATG TAGTCTGTTT TTTATGCAAA ATCTAATTTA ATATATTGAT ATTTATATCA	
1801	TTTTACGTTT CTCGTTACAG TTTCTGTAC AAAGTGTTG ATTCGAGGCT GCTAACAAAG	
1861	CCCGAAAGGA AGCTGAGTTG GCTGCTGCCA CCGCTGAGCA ATAAGTAGCA TAACCCCTTG	
1921	GGGCCTCTAA ACGGGTCTTG AGGGGTTTTT TGCTGAAAGG AGGAACTATA TCCGGATATC	
1981	CACAGGACGG GTGTGGTCGC CATGATCGCG TAGTCGATAG TGGCTCCAAG TAGCGAAGCG	
2041	AGCAGGACTG GCGGGCGGCC AAAGCGGTCG GACAGTGCTC CGAGAACGGG TGCGCATAGA	
2101	AATTGCATCA ACGCATATAG CGTAGCAGC ACGCCATAGT GACTGGCGAT GCTGTCCGAA	
2161	TGGACGATAT CCCGCAAGAG GCCCGGCAGT ACCGGCATAA CCAAGCCTAT GCCTACAGCA	
2221	TCCAGGGTGA CGGTGCCGAG GATGACGATG AGCGCATTGT TAGATTTTCAT ACACGGTGCC	
2281	TGACTGCGTT AGCAATTTAA CTGTGATAAA CTACCGCATT AAAGCTTATC GATGATAAGC	
2341	TGTCAAACAT GAGAATTCTT GAAGACGAAA GGGCCTCGTG ATACGCCTAT TTTTATAGGT	
2401	TAATGTCATG ATAATAATGG TTTCTTAGAC GTCAGGTGGC ACTTTTCGGG GAAATGTGCG	
2461	CGGAACCCCT ATTTGTTTAT TTTTCTAAAT ACATTCAAAT ATGTATCCGC TCATGAGACA	
2521	ATAACCCTGA TAAATGCTTC AATAATATTG AAAAAGGAAG AGTATGAGTA TTCAACATTT	
2581	CCGTGTCGCC CTTATTCCCT TTTTTCGGC ATTTTGCCTT CCTGTTTTTG CTCACCCAGA	
2641	AACGCTGGTG AAAGTAAAAG ATGCTGAAGA TCAGTTGGGT GCACGAGTGG GTTACATCGA-	

FIGURE 37B

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2701 ACTGGATCTC AACAGCGGTA AGATCCTTGA GAGTTTTTCGC CCCGAAGAAC GTTTTCCAAT
2761 GATGAGCACT TTAAAGTTC TGCTATGTGG CGCGGTATTA TCCCGTGTG ACGCCGGGCA
2821 AGAGCAACTC GGTGCGCCGA TACACTATTC TCAGAATGAC TTGGTTGAGT ACTCACCAGT
2881 CACAGAAAAG CATCTTACGG ATGGCATGAC AGTAAGAGAA TTATGCAGTG CTGCCATAAC
2941 CATGAGTGAT AACACTGCGG CCAACTTACT TCTGACAACG ATCGGAGGAC CGAAGGAGCT
3001 AACCGCTTTT TTGCACAACA TGGGGGATCA TGTAACTCGC CTTGATCGTT GGGAAACCGGA
3061 GCTGAATGAA GCCATACCAA ACGACGAGCG TGACACCACG ATGCCTGCAG CAATGGCAAC
3121 AACGTTGCGC AAACATTTAA CTGGCGAACT ACTTACTCTA GCTTCCCGGC AACAAATTAAT
3181 AGACTGGATG GAGGCGGATA AAGTTGCAGG ACCACTTCTG CGCTCGGCC TTCCGGCTGG
3241 CTGGTTTATT GCTGATAAAT CTGGAGCCGG TGAGCGTGGG TCTCGCGGTA TCATTGCAGC
3301 ACTGGGGCCA GATGGTAAGC CCTCCCGTAT CGTAGTTATC TACACGACGG GGAGTCAGGC
3361 AACTATGGAT GAACGAAATA GACAGATCGC TGAGATAGGT GCCTCACTGA TTAAGCATTG
3421 GTAACGTGCA GACCAAGTTT ACTCATATAT ACTTTAGATT GATTTAAAAC TTCATTTTTTA
3481 ATTTAAAAGG ATCTAGGTGA AGATCCTTTT TGATAATCTC ATGACCAAAA TCCCTTAACG
3541 TGAGTTTTCG TTCCACTGAG CGTCAGACCC CGTAGAAAAG ATCAAAGGAT CTTCTTGAGA
3601 TCCTTTTTTT CTGCGCGTAA TCTGCTGCTT GCAAACAAAA AAACCACCGC TACCAGCGGT
3661 GGTGTGTTTG CCGGATCAAG AGCTACCAAC TCTTTTTCCG AAGGTAAC TGCTTCAGCAG
3721 AGCGCAGATA CCAAATACTG TCCTTCTAGT GTAGCCGTAG TTAGGCCACC ACTTCAAGAA
3781 CTCTGTAGCA CCGCCTACAT ACCTCGCTCT GCTAATCCTG TTACCACTGG CTGCTGCCAG
3841 TGCGGATAAG TCGTGTCTTA CCGGGTTGGA CTCAAGACGA TAGTTACCG ATAAGGCGCA
3901 GCGGTCGGGC TGAACGGGGG GTTCGTGCAC ACAGCCAGC TTGGAGCGAA CGACCTACAC
3961 CGAACTGAGA TACCTACAGC GTGAGCTATG AGAAAGCGCC ACGCTTCCCG AAGGGAGAAA
4021 GGCGGACAGG TATCCGGTAA GCGGCAGGGT CGGAACAGGA GAGCGCACGA GGGAGCTTCC
4081 AGGGGGAAC GCCTGGTATC TTTATAGTCC TGTGCGGTTT CGCCACCTCT GACTTGAGCG
4141 TCGATTTTGT TGATGCTCGT CAGGGGGGCG GAGCCTATGG AAAAACGCCA GCAACGCGGC
4201 CTTTTTACGG TTCCTGGCCT TTTGCTGCC TTTTGCTCAC ATGTTCTTTC CTGCGTTATC
4261 CCCTGATTCT GTGGATAACC GTATTACCGC CTTTGAGTGA GCTGATACCG CTCGCCGAG
4321 CCGAACGACC GAGCGCAGCG AGTCAGTGAG CGAGGAAGCG GAAGAGCGCC TGATGCGGTA
4381 TTTTCTCCTT ACGCATCTGT GCGGTATTTT ACACCGCATA TATGGTGCAC TCTCAGTACA
4441 ATCTGCTCTG ATGCCGCATA GTTAAGCCAG TATACATCC GCTATCGCTA CGTGACTGGG
4501 TCATGGCTGC GCCCGACAC CCGCCACAC CCGCTGACGC GCCCTGACGG GCTTGTCTGC
4561 TCCCGGCATC CGCTTACAGA CAAGCTGTGA CCGTCTCCGG GAGCTGCATG TGTCAGAGGT
4621 TTTACCGTTC ATCACCAGAA CGCGCAGGGC AGCTGCGGTA AAGCTCATCA GCGTGGTCTG
4681 GAAGCGATTTC ACAGATGTCT GCCTGTTTCAT CCGCGTCCAG CTCGTTGAGT TTCTCCAGAA
4741 GCGTTAATGT CTGGCTTCTG ATAAAGCGGG CCATGTTAAG GCGGTTTTT TCCTGTTTGG
4801 TCACTGATGC CTCCGTGTAA GGGGGATTTC TGTTTCATGGG GGTAATGATA CCGATGAAAC
4861 GAGAGAGGAT GCTCACGATA CGGGTTACTG ATGATGAACA TGCCCGGTTA CTGGAACGTT
4921 GTGAGGGTAA ACAACTGGCG GTATGGATGC GGCGGGACCA GAGAAAATC ACTCAGGGTC
4981 AATGCCAGCG CTTCTGTTAAT ACAGATGTAG GTGTTCCACA GGGTAGCCAG CAGCATCCTG
5041 CGATGCAGAT CCGGAACATA ATGGTGCAGG GCGTGACTT CCGCGTTTCC AGACTTTACG
5101 AAACACGGAA ACCGAAGACC ATTCATGTTG TTGCTCAGGT CGCAGACGTT TTGCAACAGC
5161 AGTCGCTTCA CGTTCGCTCG CGTATCGGTG ATTCATTCTG CTAACCACTA AGGCAACCCC
5221 GCCAGCCTAG CCGGGTCCTC AACGACAGGA GCACGATCAT GCGCACCCGT GGCCAGGACC
5281 CAACGCTGCC CGAGATGCGC CGCGTGCGGC TGCTGGAGAT GGCGGACGCG ATGGATATGT
5341 TCTGCCAAGG GTTGGTTTGC GCATTACAG TTCTCCGCAA GAATTGATTG GCTCCAATTC
5401 TTGGAGTGGT GAATCCGTTA GCGAGGTGCC GCCGGCTTCC ATTCAGGTCG AGGTGGCCCG
5461 GCTCCATGCA CCGCGACGCA ACGCGGGGAG GCAGACAAGG TATAGGGCGG CGCCTACAAT
5521 CCATGCCAAC CCGTTCCATG TGCTCGCCGA GGCGGCATAA ATCGCCGTGA CGATCAGCGG
5581 TCCAGTGATC GAAGTTAGGC TGGAAGAGC CGCGAGCGAT CCTTGAAGCT GTCCCTGATG
5641 TCTGTCATCT ACCTGCCTGG ACAGCATGGC CTGCAACGCG GGCATCCCGA TGCCGCCGGA
5701 AGCGAGAAGA ATCATAATGG GGAAGGCCAT CCAGCCTCGC GTCGCGAAGC CCAGCAAGAC
5761 GTAGCCCAGC GCGTCGGCCG CCATGCCGCG GATAATGGCC TGCTTCTCGC CGAAACGTTT
5821 GGTGGCGGGA CCAGTGACGA AGGCTTGAGC GAGGGCGTGC AAGATTCCGA ATACCGCAAG
5881 CGACAGGCCG ATCATCGTCG CGCTCCAGCG AAAGCGGTCC TCGCCGAAAA TGACCCAGAG
5941 CGCTGCCGGC ACCTGTCCTA CGAGTTGCAT GATAAAGAAG ACAGTCATAA GTGCGGCGAC
6001 GATAGTCATG CCCCAGCGCC ACCGGAAGGA GCTGACTGGG TTGAAGGCTC TCAAGGGCAT
6061 CGGTCGATCG ACGCTCTCCC TTATGCGACT CCTGCATTAG GAAGCAGCCC AGTAGTAGGT
6121 TGAGGCCGTT GAGCACCGCC GCCGCAAGGA ATGGTGCATG CAAGGAGATG GCGCCCAACA-

FIGURE 37C

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6181 GTCCCCCGGC CACGGGGCCT GCCACCATAC CCACGCCGAA ACAAGCGCTC ATGAGCCCGA
6241 AGTGGCGAGC CCGATCTTCC CCATCGGTGA TGTCGGCGAT ATAGGCGCCA GCAACCGCAC
6301 CTGTGGCGCC GGTGATGCCG GCCACGATGC GTCCGGCGTA GAGGATCGAG ATCT

FIGURE 37D

Figure 38A: pDEST18

FastBac Transfer Vector with p10
Baculovirus Promoter

1 gaagacctcg gccgtcgccg cgttgccgg tgggtgctgac cccggatgaa gtggttcgca
cttctggagc cggcagcgcc gcgaacggcc accacgactg gggcctactt caccaagcgt

61 tccctcggttt tctggaagge gagcatcggtt tgttcgccc ggactctagc tatagttcta
aggagccaaa agaccttcgc ctcgtagcaa acaagcgggt cctgagatcg atatcaagat

121 gtggttggtt acgtatcgag caagaagcta aaacgccaaa cgcgtggag tcttctgtac
caccaaccga tgcatagttc gttctttcat ttctcgttt gcgaacctc agaacagac

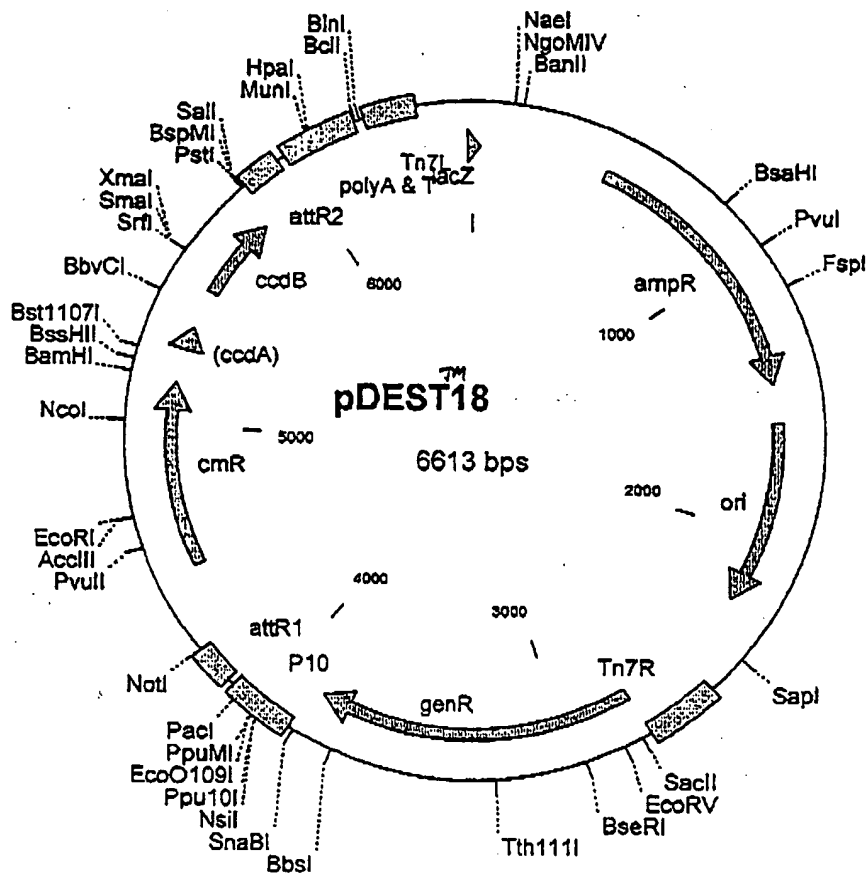
181 ttatcttaca agatctaga attaccgacc acpacaaca agggggacta tgaatctatg
ataaataatgt ttctaagtct ttatgcctag tgaatgtgt tccccctgat actttaatac

241 cattttgagg atgcccggac ctttaattca accpaaaca atatattata gtaaaatag mRNA
gtaaaactcc taaggccctg gaaatgaagt tgggtgtgt tatataaat caattatc

301 aattatctat caaatcattt gtatattaat taataacta tactgtaat tacatctat
taataaata gtttagtaa oataaatta atttatgat atgacattta atgtaanaa

361 ttacaatgag gatcatcaca agttgtaca aaaaagctga acgagaaaacg taaaatgata
aatgttactc ctagtatgt tcaaacatgt ttttcgact tgctctttgc attttactat

Int. attR1



pDEST18 6613 bp

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
474..1449	ampR
1590..2244	ori
2738..3850	genR
4251..4127	attR1
4501..5160	CmR
5280..5364	inactivated ccdA
5502..5807	ccdB
5848..5972	attR2
6595..25	lacZ

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1 GACGCGCCCT GTAGCGGCGC ATTAAGCGCG GCGGGTGTGG TGGTTACGCG CAGCGTGACC
61 GCTACACTTG CCAGCGCCCT AGCGCCCGCT CCTTTCGCTT TCTTCCCTTC CTTTCTCGCC
121 ACGTTCGCGG GCTTTCCCCG TCAAGCTCTA AATCGGGGGC TCCCTTTAGG GTTCCGATTT
181 AGTGCTTTAC GGCACCTCGA CCCCAAAAAA CTTGATTAGG GTGATGGTTC ACGTAGTGGG
241 CCATCGCCCT GATAGACGGT TTTTCGCCCT TTGACGTTGG AGTCCACGTT CTTTAATAGT
301 GGACTCTTGT TCCAAACTGG AACAACTC AACCCATCT CGGTCTATT CTTTGATTTA
361 TAAGGGATTG TGCCGATTTG GGCCTATTGG TTAATAAATG AGCTGATTTA ACAAAAATTT
421 AACGCGAATT TTAACAAAT ATTAACGTTT ACAATTTT CAG GTGGCACTTT TCGGGGAAAT
481 GTGCGCGGAA CCCCTATTTG TTTATTTTTC TAAATACATT CAAATATGTA TCCGCTCATG
541 AGACAATAAC CCTGATAAAT GCTTCAATAA TATTGAAAAA GGAAGAGTAT GAGTATTCAA
601 CATTTCCGTG TCGCCCTTAT TCCCTTTTTT GCGGCATTTT GCCTTCCTGT TTTTGCTCAC
661 CCAGAAACGC TGGTGAAAGT AAAAGATGCT GAAGATCAGT TGGGTGCACG AGTGGGTTAC
721 ATCGAACTGG ATCTCAACAG CGGTAAGATC CTTGAGAGTT TTCGCCCCGA AGAACGTTTT
781 CCAATGATGA GCACTTTTAA AGTTCTGCTA TGTGGCGCGG TATTATCCCG TATTGACGCC
841 GGGCAAGAGC AACTCGGTG CCGCATACAC TATTCTCAGA ATGACTTGTT TGAGTACTCA
901 CCAGTCACAG AAAAGCATCT TACGGATGGC ATGACAGTAA GAGAATTATG CAGTGCTGCC
961 ATAACCATGA GTGATAACAC TCGGGCCAAC TTACTTCTGA CAACGATCGG AGGACCGAAG
1021 GAGCTAACCG CTTTTTTGCA CAACATGGGG GATCATGTAA CTCGCCTTGA TCGTTGGGAA
1081 CCGGAGCTGA ATGAAGCCAT ACCAAACGAC GAGCGTGACA CCACGATGCC TGTAGCAATG
1141 GCAACAACGT TCGCAAACCT ATTAAGTGGC GAACTACTTA CTCTAGCTTC CCGGCAACAA
1201 TTAATAGACT GGATGGAGGC GGATAAAGTT GCAGGACCAC TTCTGCGCTC GGCCCTTCCG
1261 GCTGGCTGGT TTATTGCTGA TAAATCTGGA GCCGGTGAGC GTGGGTCTCG CCGTATCATT
1321 GCAGCACTGG GGCCAGATGG TAAGCCCTCC CGTATCGTAG TTATCTACAC GACGGGGAGT
1381 CAGGCAACTA TGGATGAACG AAATAGACAG ATCGCTGAGA TAGGTGCCTC ACTGATTAAG
1441 CATTGGTAAC TGTCAGACCA AGTTTACTCA TATATACTTT AGATTGATTT AAAACTTCAT
1501 TTTTAATTTA AAAGGATCTA GGTGAAGATC CTTTTTGATA ATCTCATGAC CAAAATCCCT
1561 TAACGTGAGT TTTTCGTTCCA CTGAGCGTGA GACCCGCTAG AAAAGATCAA AGGATCTTCT
1621 TGAGATCCTT TTTTCTGCG CGTAATCTGC TGCTTGCAAA CAAAAAACC ACCGCTACCA
1681 GCGGTGGTTT GTTTGCCGGA TCAAGAGCTA CCAACTCTTT TTCCGAAGGT AACTGGCTTC
1741 AGCAGAGCGC AGATACCAA TACTGTCTTT CTAGTGTAGC CGTAGTTAGG CCACCACTTC
1801 AAGAACTCTG TAGCACCACC TACATACCTC GCTCTGCTAA TCCTGTTACC AGTGGCTGCT
1861 GCCAGTGGCG ATAAGTCGTG TCTTACCGGG TTGGACTCAA GACGATAGTT ACCGGATAAG
1921 GCGCAGCGGT CCGGCTGAAC GGGGGGTTCC TGCACACAGC CCAGCTTGGA GCGAACGACC
1981 TACACCGAAC TGAGATACCT ACAGCGTGAG CATTGAGAAA GCGCCACGCT TCCCGAAGGG
2041 AGAAAGGCGG ACAGGTATCC GGTAAAGCGG AGGGTCGGAA CAGGAGAGCG CACGAGGGAG
2101 CTTCCAGGGG GAAACGCCTG GTATCTTTAT AGTCTGTGCG GGTTCGCCA CCTCTGACTT
2161 GAGCGTGGAT TTTTGTGATG CTCGTAGGG GGGCGGAGCC TATGGAAAAA CGCCAGCAAC
2221 GCGGCCTTTT TACGTTCTCT GGCCTTTTGC TGGCCTTTTG CTCACATGTT CTTTCTGCG
2281 TTATCCCCTG ATTCTGTGGA TAACCGTATT ACCGCCTTTG AGTGAGCTGA TACCGCTCGC
2341 CGCAGCCGAA CGACCGAGCG CAGCGAGTCA GTGAGCGAGG AAGCGGAAGA GCGCCTGATG
2401 CGGTATTTTC TCCTTACGCA TCTGTGCGGT ATTTACACCC GCAGACCAGC CGCGTAACCT
2461 GGCAAAATCG GTTACGTTG AGTAATAAAT GGATGCCCTG CGTAAGCGGG TGTGGGCGGA-

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FIGURE 38B

2521 CAATAAAGTC TTAAACTGAA CAAAATAGAT CTAAACTATG ACAATAAAGT CTTAAACTAG
2581 ACAGAATAGT TGTAAGTGA AATCAGTCCA GTTATGCTGT GAAAAAGCAT ACTGGACTTT
2641 TGTTATGGCT AAAGCAAACCT CTTCAATTTT TGAAGTGCAA ATTGCCCGTC GTATTAAAGA
2701 GGGGCGTGGC CAAGGGCATG GTAAAGACTA TATTCGCGGC GTTGTGACAA TTTACCGAAC
2761 AACTCCGCGG CCGGGAAGCC GATCTCGGCT TGAACGAATT GTTAGGTGGC GGTACTTGGG
2821 TCGATATCAA AGTGCATCAC TTCTTCCCGT ATGCCCAACT TTGTATAGAG AGCCACTGCG
2881 GGATCGTCAC CGTAATCTGC TTGCACGTAG ATCACATAAG CACCAAGCGC GTTGGCCTCA
2941 TGCTTGAGGA GATTGATGAG CGCGGTGGCA ATGCCCTGCC TCCGGTGCTC GCCGGAAGCT
3001 GCGAGATCAT AGATATAGAT CTCCTACGCG GGCTGCTCAA ACCTGGGCAG AACGTAAGCC
3061 GCGAGAGCGC CAACAACCGC TTCTTGGTCG AAGGCAGCAA GCGCGATGAA TGTCTTACTA
3121 CGGAGCAAGT TCCGAGGTA ATCGAGTCC GGCTGATGTT GGGAGTAGGT GGCTACGTCT
3181 CCGAATCTAC GACCGAAAAG ATCAAGAGCA GCCCGCATGG ATTTGACTTG GTCAGGCGCG
3241 AGCCTACATG TGCGAATGAT GCCCATACTT GAGCCACCTA ACTTTGTTTT AGGGCGACTG
3301 CCCTGCTGCG TAACATCGTT GCTGCTGCGT AACATCGTTG CTGCTCCATA ACATCAAAACA
3361 TCGACCCACG GCGTAACGCG CTTGCTGCTT GGATGCCCGA GGCATAGACT GTACAAAAAA
3421 ACAGTCATAA CAAGCCATGA AAACCGCCAC TGCGCCGTTA CCACCGCTGC GTTCGGTCAA
3481 GGTCTGAGAC CAGTTGCGTG AGCGCATACG CTACTTGTCAT TACAGTTTAC GAACCGAACA
3541 GGCTTATGTC AACTGGGTTT GTGCCCTTCT CCGTTTCCAC GGTGTGCGTC ACCCGGCAAC
3601 CTTGGGCAGC AGCGAAGTCG AGGCATTCTT GTCCTGGCTG GCGAACGAGC GCAAGCTTTC
3661 GGTCTCCACG CATCGTCAGG CATTGGCGCG CTTGCTGTTT TTCTACGGCA AGGTGCTGTG
3721 CACGGATCTG CCCTGGCTTC AGGAGATCGG AAGACCTCGG CCGTCGCGGC GCTTGCCGGT
3781 GGTGCTGACC CCGGATGAAG TGGTTCGCAT CCTCGGTTTT CTGGAAGGCG AGCATCSTTT
3841 GTTCGCCCAG GACTCTAGCT ATAGTTCTAG TGGTTGGCTA CGTATCGAGC AAGAAAATAA
3901 AACGCCAAAC GCGTTGGAGT CTTGTGTGCT ATTTTACAA AGATTCAGAA ATACGCATCA
3961 CTTACAACAA GGGGGACTAT GAAATTATGC ATTTTGAGGA TGCCGGGACC TTTAATTCAA
4021 CCCAACACAA TATATTATAG TTAAATAAGA ATTATTTATC AAATCATTTG TATATTAAAT
4081 AAAATACTAT ACTGTAAATT ACATTTTATT TACAATGAGG ATCATCACAA GTTTGTACAA
4141 AAAAGCTGAA CGAGAAACGT AAAATGATAT AAATATCAAT ATATTAAAT AGATTGTGCA
4201 TAAAAACAG ACTACATAAT ACTGTAAAC ACAACATATC CAGTCACTAT GCGCGCCGCT
4261 AAGTTGGCAG CATCACCCGA CGCATTTTGC GCCGAATAAA TACCTGTGAC GGAAGATCAC
4321 TTTCGAGAAT AAATAAATCC TGGTGTCCCT GTTGATACCG GGAAGCCCTG GGCCAACTTT
4381 TGGCGAAAAT GAGACGTTGA TCGGCACGTA AGAGGTTCCA ACTTTCACCA TAATGAAATA
4441 AGATCACTAC CGGGCGTATT TTTTGAGTTA TCGAGATTTT CAGGAGCTAA GGAAGCTAAA
4501 ATGGAGAAAA AAATCACTGG ATATAACCAC GTTGATATAT CCAATGGCA TCGTAAAGAA
4561 CATTTTGAGG CATTTTCAGT AGTTGCTCAA TGTACCTATA ACCAGACCGT TCAGCTGAT
4621 ATTACGGCCT TTTTAAAGAC CGTAAAGAAA AATAAGCACA AGTTTATCC GGCCTTTATT
4681 CACATCTCTG CCCGCTGAT GAATGCTCAT CCGGAATTCC GTATGGCAAT GAAAGACGGT
4741 GAGCTGGTGA TATGGGATAG TGTTACCCTT TGTTACACCG TTTTCCATGA GCAAACGAA
4801 ACGTTTTTAT CGCTCTGGAG TGAATACCAC GACGATTTCC GGCAGTTTCT ACACATATAT
4861 TCGCAAGATG TGGCGTGTTA CGGTGAAAAC CTGGCCTATT TCCCTAAAGG GTTTATTGAG
4921 AATATGTTTT TCGTCTCAGC CAATCCCTGG GTGAGTTTCA CCAGTTTGA TTTAAACGTG
4981 GCCAATATGG ACAACTTCTT CGCCCCGTT TTCAACATGG GCAAATATTA TACGCAAGGC
5041 GACAAGGTGC TGATGCCGCT GGCATTGAG GTTCATCATG CCGTCTGTGA TGGCTTCCAT
5101 GTCGGCAGAA TGCTTAATGA ATTACAACAG TACTGCGATG AGTGGCAGGG CGGGGCGTAA
5161 ACGCGTGGAT CCGGCTTACT AAAAGCCAGA TAACAGTATG CGTATTGCG CGCTGATTTT
5221 TGCGGTATAA GAATATATAC TGATATGTAT ACCCGAAGTA TGTCAAAAAG AGGTGTGCTA
5281 TGAAGCAGCG TATTACAGTG ACAGTTGACA GCGACAGCTA TCAGTTGCTC AAGGCATATA
5341 TGATGTCAAT ATCTCCGGTC TGGTAAGCAC AACCATGCAG AATGAAGCCC GTCGCTGCG
5401 TGCCGAACGC TGGAAAGCGG AAAATCAGGA AGGGATGGCT GAGGTGCCCC GGTTTATTGA
5461 AATGAACCGC TCTTTGCTG ACGAGAACAG GGACTGGTGA AATGCAGTTT AAGGTTTACA
5521 CCTATAAAAG AGAGAGCCGT TATCGTCTGT TTGTGGATGT ACAGAGTGAT ATTATTGACA
5581 CGCCCGGGCG ACGGATGGTG ATCCCCCTGG CCAGTGCACG TCTGCTGTCA GATAAAGTCT
5641 CCCGTGAACT TTACCCGGTG GTGCATATCG GGGATGAAAG CTGGCGCATG ATGACCACCG
5701 ATATGGCCAG TGTGCCGGTC TCCGTTATCG GGAAGAGT GGCTGATCTC AGCCACCGCG
5761 AAAATGACAT CAAAACGCC ATTAACCTGA TGTTCTGGGG AATATAAATG TCAGGCTCCC
5821 TTATACACAG CCAGTCTGCA GGTCGACCAT AGTGACTGGA TATGTTGTGT TTTACATAT
5881 TATGTAGTCT GTTTTTTATG CAAAATCTAA TTTAATATAT TGATATTTAT ATCATTTTAC
5941 GTTCTCGTT CAGCTTTCTT GTACAAAGTG GTGATAGCTT GTCGAGAAGT ACTAGAGGAT

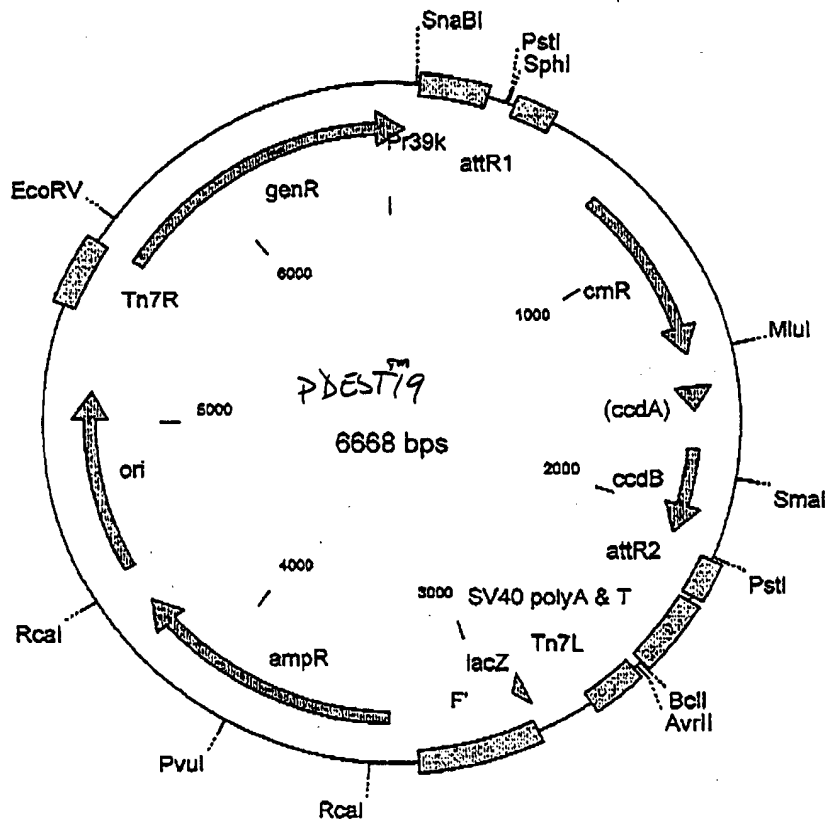
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6001 CATAATCAGC CATACCACAT TTGTAGAGGT TTTACTTGCT TTAAAAAACC TCCCACACCT
6061 CCCCTGAAC CTGAAACATA AAATGAATGC AATTGTTGTT GTTAACTTGT TTATTGCAGC
6121 TTATAATGGT TACAAATAAA GCAATAGCAT CACAAATTTC ACAAATAAAG CATTTTTTTC
6181 ACTGCATTCT AGTTGTGGTT TGTCCAAACT CATCAATGTA TCTTATCATG TCTGGATCTG
6241 ATCACTGCTT GAGCCTAGGA GATCCGAACC AGATAAGTGA AATCTAGTTC CAAACTATTT
6301 TGTCATTTTT AATTTTCGTA TTAGCTTACG ACGCTACACC CAGTTCCCAT CTATTTTGTC
6361 ACTCTTCCCT AAATAATCCT TAAAAACTCC ATTTCCACCC CTCCCAGTTC CCAACTATTT
6421 TGTCCGCCCC CAGCGGGGCA TTTTCTTCC TGTTATGTTT TTAATCAAAC ATCCTGCCAA
6481 CTCCATGTGA CAAACCGTCA TCTTCGGCTA CTTTTTCTCT GTCACAGAAT GAAAATTTTT
6541 CTGTCATCTC TTCGTTATTA ATGTTTGTA TTAGCTGAAT ATCAACGCTT ATTTGCAGCC
6601 TGAATGGCGA ATG

FIGURE 38D

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1 ggtgacgccc tcattcttcc attgtaacgt aaatggcaac ttgtagatga acgcgctgtc
 ccactgcggc agtagaaagg taacattgca ttaccggtg aacatctact tgcgcgacag
 61 aaaaaaccgg ccagtttctt ccacaaactc ggcacgggt gtctcgtaaa cttttgcgtc
 ttttttggcc ggtcaaagaa ggtgtttgag cgcgtgcga cagagcattt gaaaacgcag
 121 // gcaacaatcg cgatgacctc gtggtatgga aatttttct aaaaaagtgt cgttcatgtc //
 // cgttgttagc gctactggag caccatacct ttaaaaaaga ttttttcaca gcaagtacag //
 181 // ggcggcgggc ttcgcgtctc ggtacgcgcg acgggcacac agcaggacag ctttgtccgg
 // ccgcgcgcgc aagcgcgagg ccatgcgcgc tgcccggtg tcgtccgtg ggaacaggcc
 241 ctcgattatc ataaacaatc ctgcaggcat gcaagctgga tcatacaag ttgtacaaa
 gagctaatag tatttgtag gacgtccgta cgttcgacct agtagcttc aaacatgttt
 Int V



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pDEST19 6668 bp (rotated to position 1000)

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
515..391		attR1
765..1424		CmR
1544..1628		inactivated ccdA
1766..2071		ccdB
2112..2236		attR2
2852..2895		lacZ
3344..4319		ampR
4460..5114		ori
5608..52		genR
1	AGTGGTTTCG	ATCCTCGGTT TTCTGGAAGG CGAGCATCGT TTGTTGCCCC AGGACTCTAG
61	CTATAGTTCT	AGTGGTTGGC TACGTATATC AAATACTTGT AGGTGACGCC GTCATCTTTC
121	CATTGTAACG	TAAATGGCAA CTGTAGATG AACGCGCTGT CAAAAAACCG GCCAGTTTCT
181	TCCACAAACT	CGCGCACGGC TGTCTCGTAA ACTTTTGCGT CGCAACAATC GCGATGACCT
241	CGTGGTATGG	AAATTTTTTC TAAAAAAGTG TCGTTCATGT CGGCGGCGGG CGCGTTCGCG
301	CTCCGGTACG	CGCGACGGGC ACACAGCAGG ACAGCCTTGT CCGGCTCGAT TATCATAAAC
361	AATCCTGCAG	GCATGCAAGC TCGATCATC ACAAGTTTGT ACAAAAAAGC TGAACGAGAA
421	ACGTAAATG	ATATAAATAT CAATATATTA AATTAGATTT TGCATAAAAA ACAGACTACA
481	TAATACTGTA	AAACACAACA TATCCAGTCA CTATGGCGGC CGCTAAGTTG GCAGCATCAC
541	CCGACGCACT	TTGCGCCGAA TAAATACCTG TGACGGAAGA TCACTTCGCA GAATAAATAA
601	ATCCTGGTGT	CCCTGTTGAT ACCGGGAAGC CCTGGGCCAA CTTTGGCGA AAATGAGACG
661	TTGATCGGCA	CGTAAGAGGT TCCAACTTTC ACCATAATGA AATAAGATCA CTACCGGGCG
721	TATTTTTTGA	GTTATCGAGA TTTTCAGGAG CTAAGGAAGC TAAAATGGAG AAAAAATCA
781	CTGGATATAC	CACCGTTGAT ATATCCCAAT GGCATCGTAA AGAACATTTT GAGGCATTTT
841	AGTCAGTTGC	TCAATGTACC TATAACCAGA CCGTTCAGCT GGATATTACG GCCTTTTTAA
901	AGACCGTAAA	GAAAAATAAG CACAAGTTTT ATCCGGCCTT TATTCACATT CTTGCCCGCC
961	TGATGAATGC	TCATCCGGA TCCCGTATGG CAATGAAAGA CGGTGAGCTG GTGATATGGG
1021	ATAGTGTTCA	CCCTTGTTAC ACCGTTTTCC ATGAGCAAAC TGAAACGTTT TCATCGCTCT
1081	GGAGTGAATA	CCACGACGAT TTCCGGCAGT TTCTACACAT ATATTCGCAA GATGTGGCGT
1141	GTTACGGTGA	AAACCTGGCC TATTTCCCTA AAGGGTTTAT TGAGAATATG TTTTTCGTCT
1201	CAGCCAATCC	CTGGGTGAGT TTCACCAAGT TTGATTTAAA CGTGGCCAAT ATGGACAAC
1261	TCTTCGCCCC	CGTTTTCAAC ATGGGCAAAT ATTATACGCA AGGCGACAAG GTGCTGATGC
1321	CGCTGGCGAT	TCAGGTTTCA CATGCCGTCT GTGATGGCTT CCATGTCCGC AGAATGCTTA
1381	ATGAATTACA	ACAGTACTGC GATGAGTGGC AGGGCGGGGC GTAAACGCGT GGATCCGGCT
1441	TACTAAAAGC	CAGATAACAG TATCGGTATT TGCAGCTGA TTTTTCGCTG ATAAGAATAT
1501	ATACTGATAT	GTATACCCGA AGTATGTCAA AAAGAGGTGT GCTATGAAGC AGCGTATTAC
1561	AGTGACAGTT	GACAGCGACA GCTATCAGTT GCTCAAGGCA TATATGATGT CAATATCTCC
1621	GGTCTGGTAA	GCACAACCAT GCAGAATGAA GCGCGTCGTC TGCGTGCCGA ACGCTGGAAA
1681	GCGGAAAATC	AGGAAGGGAT GGCTGAGGTC GCGCGGTTTA TTGAAATGAA CGGCTCTTTT
1741	GCTGACGAGA	ACAGGGACTG GTGAAATGCA GTTTAAGGTT TACACCTATA AAAGAGAGAG
1801	CCGTTATCGT	CTGTTTGTGG ATGTACAGAG TGATATTATT GACACGCCCC GGCACGGAT
1861	GGTGATCCCC	CTGGCCAGTG CACGCTCTGCT GTCAGATAAA GTCTCCCGTG AACTTTACCC
1921	GGTGGTGAT	ATCGGGGATG AAAGCTGGCG CATGATGACC ACCGATATGG CCAGTGTGCC
1981	GGTCTCCGTT	ATCGGGGAAG AAGTGGCTGA TCTCAGCCAC CGCGAAAATG ACATCAAAAA
2041	CGCCATTAA	CTGATGTTCT GGGGAATATA AATGTCAGGC TCCCTTATAC ACAGCCAGTC
2101	TGCAGGTCGA	CCATAGTGAC TGGATATGTT GTGTTTTACA GTATTATGTA GTCTGTTTTT
2161	TATGCAAAAT	CTAATTTAAT ATATTGATAT TTATATCATT TTACGTTTCT CGTTCAGCTT
2221	TCTGTACAA	AGTGGTGATC GAGAAGTACT AGAGGATCAT AATCAGCCAT ACCACATTTG
2281	TAGAGGTTTT	ACTTGCTTTA AAAAACCTCC CACACCTCCC CCTGAACCTG AAACATAAAA
2341	TGAATGCAAT	TGTTGTTGTT AACTTGTTTA TTGCAGCTTA TAATGGTTAC AAATAAAGCA
2401	ATAGCATCAC	AAATTTTACA AATAAAGCAT TTTTTCAC
2461	CCAACTCAT	CAATGTATCT TATCATGTCT GGATCTGATC ACTGCTTGAG CCTAGGAGAT
2521	CCGAACCAGA	TAAGTGAAAT CTAGTTCCAA ACTATTTTGT CATTTTTAAT TTTTCGTATTA
2581	GCTTACGACG	CTACACCCAG TTCCCATCTA TTTTGTCACT CTTCCCTAAA TAATCCTTAA-

FIGURE 39B

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2641 AAACCTCCATT TCCACCCCTC CCAGTTCCCA ACTATTTTGT CCGCCACAG CGGGGCATTT
2701 TTCTTCCTGT TATGTTTTTA ATCAAACATC CTGCCAACTC CATGTGACAA ACCGTCATCT
2761 TCGGCTACTT TTTCTCTGTC ACAGAATGAA AATTTTTCTG TCATCTCTTC GTTATTAATG
2821 TTTGTAATTG ACTGAATATC AACGCTTATT TGCAGCCTGA ATGGCGAATG GACGCGCCCT
2881 GTAGCGGCGC ATTAAGCGCG GCGGGTGTGG TGGTTACGCG CAGCGTGACC GCTACACTTG
2941 CCAGCGCCCT AGCGCCCGCT CCTTCGCTT TCTTCCTTC CTTTCTCGCC ACGTTCGCGG
3001 GCTTTCCCG TCAAGCTCTA AATCGGGGGC TCCCTTAGG GTTCCGATTT AGTGCTTTAC
3061 GGCACCTCGA CCCCCAAAAA CTGATTAGG GTGATGGTTC ACGTAGTGGG CCATCGCCCT
3121 GATAGACGGT TTTTCGCCCT TTGACGTTGG AGTCCACGTT CTTTAATAGT GGACTCTTGT
3181 TCCAAACTGG AACAACTC AACCTATCT CGGTCTATTC TTTTGATTTA TAAGGGATTT
3241 TGCCGATTTT GGCCTATTGG TTAAAAAATG AGCTGATTTA ACAAAAATTT AACGCGAATT
3301 TTAACAAAAT ATTAACGTTT ACAATTTTCTG GTGGCACTTT TCGGGGAAAT GTGCGCGGAA
3361 CCCCTATTTG TTTATTTTTT TAAATACATT CAAATATGTA TCCGCTCATG AGACAATAAC
3421 CCTGATAAAT GCTTCAATAA TATTGAAAAA GGAAGAGTAT GAGTATTCAA CATTTCCGTG
3481 TCGCCCTTAT TCCCTTTTTT GCGGCATTTT GCCTTCCTGT TTTTGCTCAC CCAGAAACGC
3541 TGGTGAAAGT AAAAGATGCT GAAGATCAGT TGGGTGCACG AGTGGGTTAC ATCGAACTGG
3601 ATCTCAACAG CGGTAAGATC CTTGAGAGTT TTCGCCCCGA AGAACGTTTT CCAATGATGA
3661 GCACTTTTAA AGTTCGTGTA TGTGGCGCGG TATTATCCCG TATTGACGCC GGGCAAGAGC
3721 AACTCGGTG CCGCATACAC TATTCTCAGA ATGACTTGGT TGAGTACTCA CCAGTACAG
3781 AAAAGCATCT TACGGATGGC ATGACAGTAA GAGAATTATG CAGTGCTGCC ATAACCATGA
3841 GTGATAACAT TCGCGCCAAC TTACTTCTGA CAACGATCGG AGGACCGAAG GAGCTAACCG
3901 CTTTTTTGCA CAACATGGGG GATCATGTAA CTCGCCTTGA TCGTTGGGAA CCGGAGCTGA
3961 ATGAAGCCAT ACCAAACGAC GAGCGTGACA CCACGATGCC TGTAAGCAATG GCAACAACGT
4021 TGCGCAAAC ATTAACGGC GAACTACTTA CTCTAGCTTC CCGGCAACAA TTAATAGACT
4081 GGATGGAGGC GGATAAAGTT GCAGGACCAC TTCTGCGCTC GGCCCTTCCG GCTGGCTGGT
4141 TTATGCTGA TAAATCTGGA GCCGGTGAGC GTGGGTCTCG CCGGTATCATT GCAGCACTGG
4201 GGCCAGATGG TAAGCCCTCC CGTATCGTAG TTATCTACAC GACGGGGAGT CAGGCAACTA
4261 TGATGAACG AAATAGACAG ATCGCTGAGA TAGGTGCCTC ACTGATTAAG CATTGGTAAC
4321 TGTCAGACCA AGTTTACTCA TATATACTTT AGATTGATTT AAAACTTTCAT TTTTAATTTA
4381 AAAGGATCTA GGTGAAGATC CTTTTTGATA ATCTCATGAC CAAAATCCCT TAACGTGAGT
4441 TTTCTGTCCA CTGAGCGTCA GACCCGTTAG AAAAGATCAA AGGATCTTCT TGAGATCCTT
4501 TTTTCTGCG CGTAATCTGC TGCTTGCAAA CAAAAAACC ACCGCTACCA GCGGTGGTTT
4561 GTTTGCCGGA TCAAGAGCTA CCAACTCTTT TTCCGAAGGT AACTGGCTTC AGCAGAGCGC
4621 AGATACCAA TACTGTCTT CTAGTGTAGC CGTAGTTAGG CCACCACTTC AAGAACTCTG
4681 TAGCACC GCC TACATACCT GCTCTGCTAA TCCTGTTACC AGTGGCTGCT GCCAGTGGCG
4741 ATAAGTCGTG TCTTACCGGG TTGGACTCAA GACGATAGTT ACCGGATAAG GCGCAGCGGT
4801 CGGGCTGAAC GGGGGGTTG TGCACACAGC CCAGCTTGGA GCGAACGACC TACACCGAAC
4861 TGAGATACCT ACAGCGTGAG CATTGAGAAA GCGCCACGCT TCCCGAAGGG AGAAAGGCGG
4921 ACAGGTATCC GGTAAGCGGC AGGGTCGGAA CAGGAGAGCG CACGAGGGAG CTTCCAGGGG
4981 GAAACGCTG GTATCTTTAT AGTCTGTGCG GGTTCGCCA CCTCTGACTT GAGCGTCGAT
5041 TTTTGTGATG CTCGTACGGG GGGCGGAGCC TATGGAAAAA CGCCAGCAAC GCGGCCTTTT
5101 TACGGTTCTT GGCCTTTTGC TGGCCTTTTG CTCACATGTT CTTTCTGCG TTATCCCTG
5161 ATTCTGTGGA TAACCGTATT ACCGCCTTTG AGTGAGCTGA TACCGCTCGC CGCAGCCGAA
5221 CGACCGAGCG CAGCGAGTCA GTGAGCGAGG AAGCGGAAGA GCGCCTGATG CCGTATTTTC
5281 TCCTTACGCA TCTGTGCGGT ATTTACACAC GCAGACCAGC CGCGTAACCT GGCAAAATCG
5341 GTTACGGTTG AGTAATAAAT GGATGCCCTG CGTAAGCGGG TGTGGGCGGA CAATAAAGTC
5401 TTAAACTGAA CAAAATAGAT CTAAACTATG ACAATAAAGT CTTAAACTAG ACAGAATAGT
5461 TGTAACCTGA AATCAGTCCA GTTATGCTGT GAAAAAGCAT ACTGGACTTT TGTATGGCT
5521 AAAGCAAAC CTTCATTTTC TGAAGTGCAA ATTGCCGTC GTATTAAAGA GGGGCTGGC
5581 CAAGGGCATG GTAAAGACTA TATTGCGGCG GTTGTGACAA TTTACCGAAC AACTCCGCGG
5641 CCGGGAAGCC GATCTCGGCT TGAACGAATT GTTAGGTGGC GGTACTTGGG TCGATATCAA
5701 AGTGCATCAC TTCTTCCCGT ATGCCCAACT TTGTATAGAG AGCCACTGCG GGATCGTCAC
5761 CGTAATCTGC TTGCACGTAG ATCACATAAG CACCAAGCGC GTTGGCCTCA TGCTTGAGGA
5821 GATTGATGAG CGCGGTGGCA ATGCCCTGCC TCCGGTGCTC GCCGAGACT GCGAGATCAT
5881 AGATATAGAT CTTACTACGC GGCTGCTCAA ACCTGGGCGA AACGTAAGCC GCGAGAGCGC
5941 CAACAACCGC TTCTTGGTCG AAGGCAGCAA GCGCGATGAA TGTCTTACTA CGGAGCAAGT
6001 TCCCGAGGTA ATCGGAGTCC GGCTGATGTT GGGAGTAGGT GGCTACGCTC CCGAACTCAC
6061 GACCGAAAAG ATCAAGAGCA GCCCGCATGG ATTTGACTTG GTCAGGGCGG AGCCTACATG-

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FIGURE 39C

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6121 TCGGAATGAT GCCCATACTT GAGCCACCTA ACTTTGTTTT AGGGCGACTG CCCTGCTGCG
6181 TAACATCGTT GCTGCTGCGT AACATCGTTG CTGCTCCATA ACATCAAACA TCGACCCACG
6241 GCGTAACGCG CTGCTGCTT GGATGCCCGA GGCATAGACT GTACAAAAAA ACAGTCATAA
6301 CAAGCCATGA AAACCGCCAC TGCGCCGTTA CCACCGCTGC GTTCGGTCAA GGTTCTGGAC
6361 CAGTTGCGTG AGCGCATACG CTACTIONCAT TACAGTTTAC GAACCGAACA GGCTTATGTC
6421 AACTGGGTTC GTGCCTTCAT CCGTTTCCAC GGTGTGCGTC ACCCGGCAAC CTTGGGCAGC
6481 AGCGAAGTCG AGGCATTTCT GTCCTGGCTG GCGAACGAGC GCAAGGTTTC GGTCTCCACG
6541 CATCGTCAGG CATTGGCGGC CTTGCTGTTT TTCTACGGCA AGGTGCTGTG CACGGATCTG
6601 CCCTGGCTTC AGGAGATCGG AAGACCTCGG CCGTCGCGGC GCTTGCCGGT GGTGCTGACC
6661 CCGGATGA

FIGURE 39A

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Figure 40A: pDEST20 Glutathione-S-transferase Fusion with Polyhedron Promoter for Baculovirus Expression

430 ggc tac gta tac tcc gga ata tta ata gat cat gga gat aat taa aat gat
ccg atg cat atg agg cct tat aat tat cta gta cct cta tta att tta cta

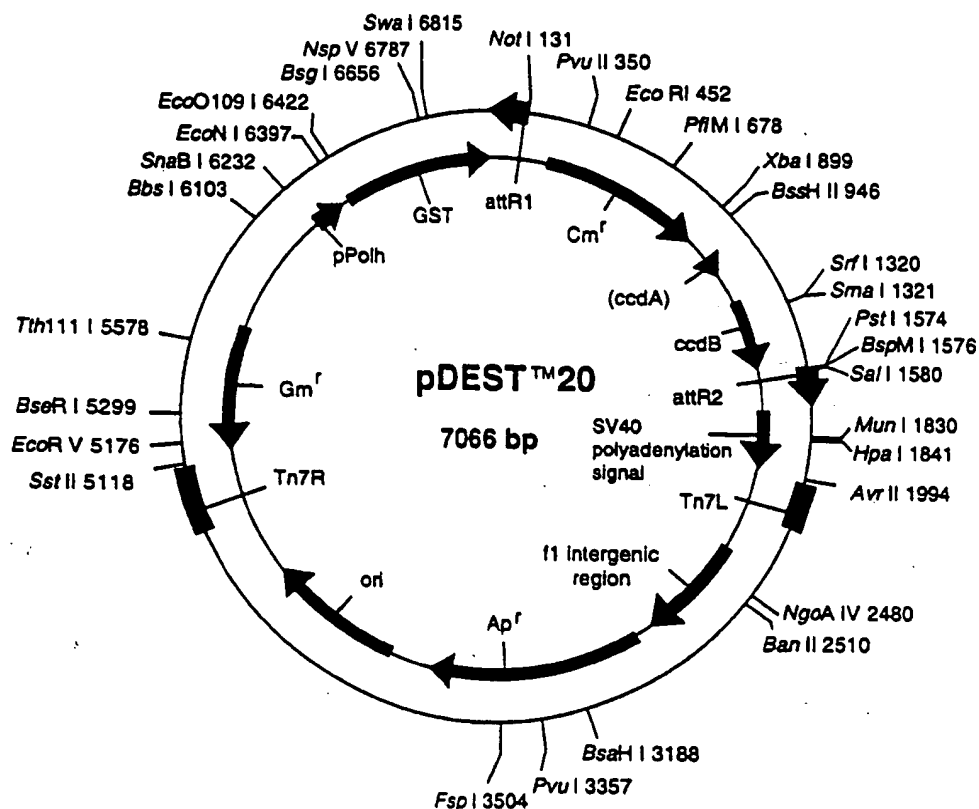
481 aac cat ctc gca aat .aaa taa gta ttt tac tgt ttt cgt aac agt ttt gta
ttg gta gag cgt tta ttt att cat aaa atg aca aaa gca ttg tca aaa cat

532 ata aaa aaa cct ata aat att ccg gat tat tca tac cgt ccc acc atc ggg
tat ttt ttt gga tat tta taa ggc cta ata agt atg gca ggg tgg tag ccc

Start Transl. → A P I - - - GST - -
583 cgc gga tcc atg gct cct ata cta ggt tat tgg aaa att aag ggc ctt gtg
gcg cct agg tac cgg gga tat gat cca ata acc ttt taa ttc ccg gaa cac

1246 S D L V P R H N Q T S L Y K R A
tcg gat ctg gtt ccg cgt cat aat caa aca agt ttg tac aaa aaa gct gaa
agc cta gac caa ggc gca gta tta gtt tgt tca aac atg ttt ttt cga ctt

1297 cga gaa acg taa aat gat ata aat atc aat ata tta aat tag at
gct ctt tgc att tta cta tat tta tag tta tat aat tta atc ta



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pDEST20 7066 bp (rotated to position 5800)

<u>Location (Base Nos.)</u>			<u>Gene Encoded</u>			
	592..1263		GST			
	1397..1273		attR1			
	1506..2165		CmR			
	2285..2369		inactivated ccdA			
	2507..2812		ccdB			
	2853..2977		attR2			
	4214..5064		ampR			
	5263..5843		ori			
1	CCACTGCGCC	GTTACCACCG	CTGCGTTCGG	TCAAGGTTCT	GGACCAGTTG	CGTGAGCGCA
61	TACGCTACTT	GCATTACAGT	TTACGAACCG	AACAGGCTTA	TGTCAACTGG	GTTTCGTGCCT
121	TCATCCGTTT	CCACGGTGTG	CGTCACCCGG	CAACCTTGGG	CAGCAGCGAA	GTCGAGGCAT
181	TTCTGTCTCTG	GCTGGCGAAC	GAGCGCAAGG	TTTCGGTCTC	CACGCATCGT	CAGGCATTGG
241	CGGCCTTGCT	GTTCTTCTAC	GGCAAGGTGC	TGTGCACGGA	TCTGCCCTGG	CTTCAGGAGA
301	TCGGAAGACC	TCGGCCGTCG	CGGCGCTTGC	CGGTGGTGCT	GACCCCGGAT	GAAGTGGTTC
361	GCATCCTCGG	TTTTCTGGAA	GGCGAGCATC	GTTTGTTCGC	CCAGGACTCT	AGCTATAGTT
421	CTAGTGGTTG	GCTACGTATA	CTCCGGAATA	TTAATAGATC	ATGGAGATAA	TTAAAATGAT
481	AACCATCTCG	CAAATAAATA	AGTATTTTAC	TGTTTTCGTA	ACAGTTTTGT	AATAAAAAAA
541	CCTATAAATA	TTCCGGATTA	TTCATACCGT	CCCACCATCG	GGCGCGGATC	CATGGCCCCCT
601	ATACTAGGTT	ATTGAAAAAT	TAAGGGCCTT	GTGCAACCCA	CTCGACTTCT	TTTGGAATAT
661	CTTGAAGAAA	AATATGAAGA	GCATTGTGAT	GAGCGCGATG	AAGGTGATAA	ATGGCGAAAC
721	AAAAAGTTTG	AATTGGGTTT	GGAGTTTCCC	AATCTTCCTT	ATTATATTGA	TGGTGTATGTT
781	AAATTAACAC	AGTCTATGGC	CATCATACGT	TATATAGCTG	ACAAGCACAA	CATGTTGGGT
841	GGTTGTCCAA	AAGAGCGTGC	AGAGATTTCA	ATGCTTGAAG	GAGCGGTTTT	GGATATTAGA
901	TACGGTGTTT	CGAGAATTGC	ATATAGTAAA	GACTTTGAAA	CTCTCAAAGT	TGATTTTCTT
961	AGCAAGCTAC	CTGAAATGCT	GAAAATGTTT	GAAGATCGTT	TATGTCATAA	AACATATTTA
1021	AATGGTGATC	ATGTAACCCA	TCCTGACTTC	ATGTTGTATG	ACGCTCTTGA	TGTTGTTTTA
1081	TACATGGACC	CAATGTGCCT	GGATGCGTTC	CCAAAATTAG	TTTGTTTTAA	AAAACGTATT
1141	GAAGCTATCC	CACAAATTGA	TAAGTACTTG	AAATCCAGCA	AGTATATAGC	ATGGCCTTTG
1201	CAGGGCTGGC	AAGCCACGTT	TGGTGGTGGC	GACCATCCTC	CAAAATCGGA	TCTGGTTCCG
1261	CGTCATAATC	AAACAAGTTT	GTACAAAAAA	GCTGAACGAG	AAACGTAAAA	TGATATAAAT
1321	ATCAATATAT	TAAATTAGAT	TTTGCAATAA	AAACAGACTA	CATAATACTG	TAAAACACAA
1381	CATATCCAGT	CACATATGGC	GCCGCATTAG	GCACCCAGG	CTTTACACTT	TATGCTTCCG
1441	GCTCGTATGT	TGTGTGGATT	TTGAGTTAGG	ATCCGGCGAG	ATTTTCAGGA	GCTAAGGAAG
1501	CTAAAATGGA	GAAAAAATC	ACTGGATATA	CCACCGTTGA	TATATCCCAA	TGGCATCGTA
1561	AAGAACATTT	TGAGGCATTT	CAGTCAGTTG	CTCAATGTAC	CTATAACCAG	ACCGTTCAGC
1621	TGGATATTAC	GGCCTTTTTA	AAGACCGTAA	AGAAAAATAA	GCACAAGTTT	TATCCGGCCT
1681	TTATTCACAT	TCTTGCCCGC	CTGATGAATG	CTCATCCGGA	ATTCCGTATG	GCAATGAAAG
1741	ACGGTGAGCT	GGTGATATGG	GATAGTGTTT	ACCCTTGTTA	CACCGTTTTT	CATGAGCAAA
1801	CTGAAACGTT	TTCATCGCTC	TGGAGTGAAT	ACCACGACGA	TTTCGGCGAG	TTTCTACACA
1861	TATATTCGCA	AGATGTGGCG	TGTTACGGTG	AAAACCTGGC	CTATTTCCCT	AAAGGGTTTA
1921	TTGAGAATAT	GTTTTTCGTC	TCAGCCAATC	CCTGGGTGAG	TTTCACCACT	TTTGATTTAA
1981	ACGTGGCCAA	TATGGACAAC	TTCTTCGCCC	CCGTTTTTAC	CATGGGCAAA	TATTATACGC
2041	AAGGCGACAA	GGTGCTGATG	CCGCTGGCGA	TTCAGGTTCA	TCATGCCGTC	TGTGATGGCT
2101	TCCATGTCCG	CAGAATGCTT	AATGAATTAC	AACAGTACTG	CGATGAGTGG	CAGGGCGGGG
2161	CGTAATCTAG	AGGATCCGGC	TTACTAAAAG	CCAGATAACA	GTATGCGTAT	TTGCGCGCTG
2221	ATTTTTGCGG	TATAAGAATA	TATACTGATA	TGTATACCCG	AAGTATGTCA	AAAAGAGGTG
2281	TGCTATGAAG	CAGCGTATTA	CAGTGACAGT	TGACAGCGAC	AGCTATCAGT	TGCTCAAGGC
2341	ATATATGATG	TCAATATCTC	CGGTCTGGTA	AGCACAACCA	TGCAGAATGA	AGCCCGTCGT
2401	CTGCGTGCCG	AACGCTGGAA	AGCGGAAAAT	CAGGAAGGGA	TGGCTGAGGT	CGCCCGGTTT
2461	ATTGAAATGA	ACGGCTCTTT	TGCTGACGAG	AACAGGGACT	GGTGAAATGC	AGTTTAAAGT
2521	TTACACCTAT	AAAAGAGAGA	GCCGTTATCG	TCTGTTTGTG	GATGTACAGA	GTGATATTAT
2581	TGACACGCCC	GGGCGACGGA	TGGTGATCCC	CCTGGCCAGT	GCACGTCTGC	TGTCAGATAA
2641	AGTCTCCCGT	GAACTTTACC	CGGTGGTGCA	TATCGGGGAT	GAAAGCTGGC	GCATGATGAC

Figure 40B

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2701 CACCGATATG GCCAGTGTGC CGGTCTCCGT TATCGGGGAA GAAGTGGCTG ATCTCAGCCA
2761 CCGCCAAAAT GACATCAAAA ACGCCATTAA CCTGATGTTC TGGGGAATAT AAATGTCAGG
2821 CTCCTTATA CACAGCCAGT CTGCAGGTCG ACCATAGTGA CTGGATATGT TGTGTTTTAC
2881 AGTATTATGT AGTCTGTTTT TTATGCAAAA TCTAATTTAA TATATTGATA TTTATATCAT
2941 TTTACGTTTC TCGTTCAGCT TTCTGTACA AAGTGGTTTG ATAGCTTGTC GAGAAGTACT
3001 AGAGGATCAT AATCAGCCAT ACCACATTG TAGAGGTTTT ACTTGCTTTA AAAAACCTCC
3061 CACACCTCCC CCTGAACCTG AAACATAAAA TGAATGCAAT TGTTGTTGTT AACTTGTTTTA
3121 TTGCAGCTTA TAATGGTTAC AAATAAAGCA ATAGCATCAC AAATTTTACA AATAAAGCAT
3181 TTTTTTCACT GCATTCTAGT TGTGGTTTGT CCAAATCAT CAATGTATCT TATCATGTCT
3241 GGATCTGATC ACTGCTTGAG CCTAGGAGAT CCGAACCAGA TAAGTGAAAT CTAGTTCCAA
3301 ACTATTTTGT CATTTTTAAT TTTCGTATTA GCTTACGACG CTACACCCAG TCCCCATCTA
3361 TTTTGTCACT CTTCCCTAAA TAATCCTTAA AAATCCATT TCCACCCCTC CCAGTTCCCCA
3421 ACTATTTTGT CCGCCACAG CGGGGCATTT TTCTTCCTGT TATGTTTTTA ATCAAACATC
3481 CTGCCAACTC CATGTGACAA ACCGTCATCT TCGGCTACTT TTTCTCTGTC ACAGAATGAA
3541 AATTTTTCTG TCATCTCTTC GTTATTAATG TTTGTAATTG ACTGAATATC AACGCTTATT
3601 TGCAGCCTGA ATGGCGAATG GACGCGCCCT GTAGCGGCGC ATTAAGCGCG GCGGGTGTGG
3661 TGGTTACGCG CAGCGTGACC GCTACACTTG CCAGCGCCCT AGCGCCCGCT CCTTTCGCTT
3721 TCTTCCCTTC CTTTCTCGCC ACGTTCGCGG GCTTTCCTCG TCAAGCTCTA AATCGGGGGC
3781 TCCCTTTAGG GTTCCGATT AGTGCTTTAC GGCACCTCGA CCCCCAAAAA CTTGATTAGG
3841 GTGATGGTTC ACGTAGTGGG CCATCGCCCT GATAGACGGT TTTTCGCCCT TTGACGTTGG
3901 AGTCCACGTT CTTTAATAGT GGACTCTTGT TCCAACTGG AACAACACTC AACCCTATCT
3961 CGGTCTATTC TTTTGATTTA TAAGGGATTT TGCCGATTTC GGCTATTGG TTAATAAATG
4021 AGCTGATTTA ACAAAAATTT AACGCGAATT TTAACAAAAT ATTAACGTTT ACAATTTTCA
4081 GTGGCACTTT TCGGGGAAAT GTGCGCGGAA CCCCTATTTG TTTATTTTTT TAAATACATT
4141 CAAATATGTA TCCGCTCATG AGACAATAAC CCTGATAAAT GCTTCAATAA TATTGAAAAA
4201 GGAAGAGTAT GAGTATTCAA CATTTCCGTG TCGCCCTTAT TCCCTTTTTT GCGGCATTTT
4261 GCCTTCCTGT TTTTGCTCAC CCAGAAACGC TGGTGAAAGT AAAAGATGCT GAAGATCAGT
4321 TGGGTGCACG AGTGGGTTAC ATCGAACTGG ATCTCAACAG CGGTAAGATC CTTGAGAGTT
4381 TFCGCCCCGA AGAACGTTTT CCAATGATGA GCACCTTTAA AGTTCTGCTA TGTGGCGCGG
4441 TATTATCCCG TATTGACGCC GGGCAAGAGC AACTCGGTG CCGCATACAC TATTCTCAGA
4501 ATGACTTGGT TGAGTACTCA CCAGTCACAG AAAAGCATCT TACGGATGGC ATGACAGTAA
4561 GAGAATTATG CAGTGCTGCC ATAACCATGA GTGATAACAC TGCGGCCAAC TTACTTCTGA
4621 CAACGCTCGG AGGACCGAAG GAGCTAACCG CTTTTTTGCA CAACATGGGG GATCATGTAA
4681 CTCGCCTTGA TCGTTGGGAA CCGGAGCTGA ATGAAGCCAT ACCAAACGAC GAGCGTGACA
4741 CCACGATGCC TGTAGCAATG GCAACAACGT TCGCGAAACT ATTAAGTGGC GAACTACTTA
4801 CTCTAGCTTC CCGGCAACAA TTAATAGACT GGATGGAGGC GGATAAAGTT GCAGGACCAC
4861 TTCTGCGCTC GGCCCTTCCG GCTGGCTGGT TTATTGCTGA TAAATCTGGA GCCGGTGAGC
4921 GTGGGTCTCG CGGTATCATT GCAGCACTGG GGCCAGATGG TAAGCCCTCC CGTATCGTAG
4981 TTATCTACAC GACGGGGAGT CAGGCAACTA TGGATGAACG AAATAGACAG ATCGCTGAGA
5041 TAGGTGCCTC ACTGATTAAG CATTGGTAAC TGTCAGACCA AGTTTACTCA TATATACTTT
5101 AGATTGATTT AAAACTTCAT TTTTAATTTA AAAGGATCTA GGTGAAGATC CTTTTTGATA
5161 ATCTCATGAC CAAAATCCCT TAACGTGAGT TTTTCGTTCA CTGAGCGTCA GACCCCGTAG
5221 AAAAGATCAA AGGATCTTCT TGAGATCCTT TTTTCTGCG CGTAATCTGC TGCTTGCAAA
5281 CAAAAAACC ACCGCTACCA GCGGTGGTTT GTTTGCCGGA TCAAGAGCTA CCAACTCTTT
5341 TTCCGAAGGT AACTGGCTTC AGCAGAGCGC AGATAACAAA TACTGTCCTT CTAGTGTAGC
5401 CGTAGTTAGG CCACCACTTC AAGAACTCTG TAGCACCGCC TACATACCTC GCTCTGCTAA
5461 TCCTGTTACC AGTGGCTGCT GCCAGTGGCG ATAAGTCGTG TCTTACCGGG TTGGACTCAA
5521 GACGATAGTT ACCGGATAAG GCGCAGCGGT CGGGCTGAAC GGGGGGTTCC TGCACACAGC
5581 CCAGCTTGGA GCGAACGACC TACCCGAAC TGAGATACCT ACAGCGTGAG CATTGAGAAA
5641 GCGCCACGCT TCCCGAAGGG AGAAAGCGCG ACAGGTATCC GGTAAGCGGC AGGGTCGAA
5701 CAGGAGAGCG CACGAGGAG CTTCCAGGG GAAACGCCTG GTATCTTTAT AGTCCTGTCTG
5761 GGTTCGCCA CCTCTGACTT GAGCGTCGAT TTTTGTGATG CTCGTCAGGG GCGCGGAGCC
5821 TATGGAAAAA CGCCAGCAAC GCGGCCTTTT TACGGTTCCT GGCCTTTTGC TGGCCTTTTG
5881 CTCACATGTT CTTTCTGCG TTATCCCTG ATTCTGTGGA TAACCGTATT ACCGCTTTTG
5941 AGTGAGCTGA TACCGCTCGC CGCAGCCGAA CGACCGAGCG CAGCGAGTCA GTGAGCGAGG
6001 AAGCGGAAGA GCGCCTGATG CGGTATTTTC TCCTTACGCA TCTGTGCGGT ATTTACACC
6061 GCAGACCAGC CGCGTAACCT GGCAAAATCG GTTACGGTTG AGTAATAAAT GGATGCCCTG
6121 CGTAAGCGGG TGTGGGCGGA CAATAAAGTC TTAAACTGAA CAAAATAGAT CTAAACTATG-

FIGURE 40C

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6181 ACAATAAAGT CTTAAACTAG ACAGAATAGT TGTAAGTGA AATCAGTCCA GTTATGCTGT
6241 GAAAAAGCAT ACTGGACTTT TGTTATGGCT AAAGCAAACCT CTCATTTTC TGAAGTGCAA
6301 ATTGCCCCGTC GTATTAAAGA GGGGCGTGGC CAAGGGCATG GTAAAGACTA TATTCGCGGC
6361 GTTGTGACAA TTTACCGAAC AACTCCGCGG CCGGGAAGCC GATCTCGGCT TGAACGAATT
6421 GTTAGGTGGC GGTACTTGGG TCGATATCAA AGTGCATCAC TTCTTCCCGT ATGCCCCAAT
6481 TTGTATAGAG AGCCACTGCG GGATCGTCAC CGTAATCTGC TTGCACGTAG ATCACATAAG
6541 CACCAAGCGC GTTGGCCTCA TGCTTGAGGA GATTGATGAG CGCGGTGGCA ATGCCCTGCC
6601 TCCGGTGCTC GCCGGAGACT GCGAGATCAT AGATATAGAT CTCACTACGC GGCTGCTCAA
6661 ACCTGGGCAG AACGTAAGCC GCGAGAGCGC CAACAACCGC TTCTTGGTCG AAGGCAGCAA
6721 GCGCGATGAA TGTCTTACTA CGGAGCAAGT TCCCGAGGTA ATCGGAGTCC GGCTGATGTT
6781 GGGAGTAGGT GGCTACGTCT CCGAACTCAC GACCGAAAAG ATCAAGAGCA GCCCGCATGG
6841 ATTTGACTTG GTCAGGGCCG AGCCTACATG TGCGAATGAT GCCCATACTT GAGCCACCTA
6901 ACTTTGTTTT AGGGCGACTG CCCTGCTGCG TAACATCGTT GCTGCTGCGT AACATCGTTG
6961 CTGCTCCATA ACATCAAACA TCGACCCACG GCGTAACGCG CTTGCTGCTT GGATGCCCCGA
7021 GGCATAGACT GTACAAAAAA ACAGTCATAA CAAGCCATGA AAACCG

FIGURE 40D

Figure 41A:

pDEST21

**2-Hybrid Vector with
DNA-Binding Domain**

ADH PROMOTER

700 ~~ttg ggc ctc tgc tat caa gta taa ata gac ctg caa tta tta atc ttt tgt~~
~~aac ggc gaa acg ata gtt cat att tat ctg gac gtt aat aat tag aaa aca~~

751 ~~ttc ctc gtc att gtt ctc gtt ccc ttt ctt cct tgt ttc ttt ttc tgc aca~~
~~aag gag cag taa caa gag caa ggg aaa gaa gga acc aag aaa aag acg tgt~~

802 ~~ata ttt caa gct ata cca agc ata caa tca act~~ cca agc ttg aag caa gcc
~~tat aaa gtt cga tat ggt tgc tat gtt agt tga~~ ggt tgc aac ttc gtt cgg

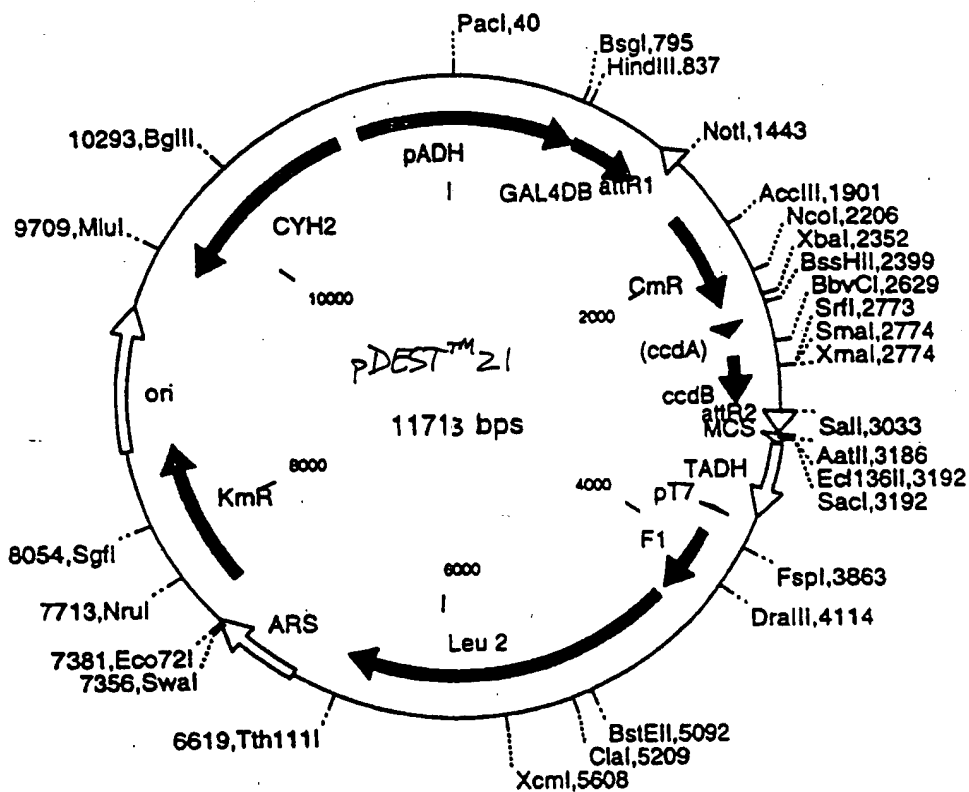
853 ~~ttc tga aag atg aag cta ctg tct tct atc gaa caa gca tgc gat att tgc~~
~~agg act ttc tac ttc gat gac aga aga tag ctt gtt cgt acg cta taa acg~~

1261 gaa gag agt agt aac aaa ggt caa aga cag ttg act gta tgg tgg agg tgg
 ctt ctc tca tca ttg ttt cca gtt tct gtc aac tga cat agc agc tcc agc

1312 ~~aat caa aca agt ttg tac aaa aaa gct gaa cga gaa acg taa aat gat ata~~
~~tta gtt tgt tca aac atg ttt ttt cga ctt gct ctt tgc att tta cta tat~~

Start Transla **M K L L S S - - Gal4-DB**

Znt ↓



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pDEST21 11713 bp (rotated to position 11000)

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
857..1322		GAL4DB
1456..1332		attR1
1706..2365		CmR
2485..2569		inactivated ccdA
2707..3012		ccdB
3053..3177		attR2
3716..3735		pT7 (T7 promoter)
3899..4354		f1 (f1 intergenic region)
4414..6642		Leu2
7541..8515		kanR
9668..10958		CYH2
11118..848		pADH (ADH promoter)

1	TTTATTATGT	TACAATATGG	AAGGGAACCT	TACACTTCTC	CTATGCACAT	ATATTAATTA
61	AAGTCCAATG	CTAGTAGAGA	AGGGGGGTAA	CACCCCTCCG	CGCTCTTTTC	CGATTTTTTT
121	CTAAACCGTG	GAATATTTTC	GATATCCTTT	TGTTGTTTCC	GGGTGTACAA	TATGGACTTC
181	CTCTTTTCTG	GCAACCAAAC	CCATACATCG	GGATTCTCTAT	AATACCTTCG	TTGGTCTCCC
241	TAACATGTAG	GTGGCGGAGG	GGAGATATAC	AATAGAACAG	ATACCAGACA	AGACATAATG
301	GGCTAAACAA	GACTACACCA	ATTACACTGC	CTCATTGATG	GTGGTACATA	ACGAACATAAT
361	ACTGTAGCCC	TAGACTTGAT	AGCCATCATC	ATATCGAAGT	TTCCTACTACC	TTTTTCCATT
421	TGCCATCTAT	TGAAGTAATA	ATAGGCGCAT	GCAACTTCTT	TTCTTTTTTT	TTCTTTTCTC
481	TCTCCCCCGT	TGTTGTCTCA	CCATATCCGC	AATGACAAAA	AAAATGATGG	AAGACACTAA
541	AGGAAAAAAT	TAACGACAAA	GACAGCACCA	ACAGATGTCG	TTGTTCCAGA	GCTGATGAGG
601	GGTATCTTCG	AACACACGAA	ACTTTTTCTT	TCCTTCATTG	ACGCACACTA	CTCTCTAATG
661	AGCAACCGTA	TACGGCCTTC	CTTCCAGTTA	CTTGAATTTG	AAATAAAAAA	AGTTTGCCGC
721	TTTGCTATCA	AGTATAAATA	GACCTGCAAT	TATTAATCTT	TTGTTTCCTC	GTCATTGTTC
781	TCGTTCCCTT	TCTTCCTTGT	TTCTTTTCTT	GCACAATATT	TCAAGCTATA	CCAAGCATAC
841	AATCAACTCC	AAGCTTGAAG	CAAGCCTCCT	GAAAGATGAA	GCTACTGTCT	TCTCTCGAAC
901	AAGCATGCGA	TATTTGCCGA	CTTAAAAAGC	TCAAGTGCTC	CAAAGAAAAA	CCGAAGTGCG
961	CCAAGTGTCT	GAAGAACAAC	TGGGAGTGTC	GCTACTCTCC	CAAAACCAAA	AGGTCTCCGC
1021	TGACTAGGGC	ACATCTGACA	GAAGTGGAA	CAAGGCTAGA	AAGACTGGAA	CAGCTATTTT
1081	TACTGATTTT	TCCTCGAGAA	GACCTTGACA	TGATTTTGAA	AATGGATTCT	TTACAGGATA
1141	TAAAAGCATT	GTAAACAGGA	TTATTTGTAC	AAGATAATGT	GAATAAAGAT	GCCGTCACAG
1201	ATAGATTGGC	TTCAGTGGAG	ACTGATATGC	CTCTAACATT	GAGACAGCAT	AGAATAAGTG
1261	CGACATCATC	ATCGGAAGAG	AGTAGTAACA	AAGGTCAAAG	ACAGTTGACT	GTATCGTCCA
1321	GGTCGAATCA	AACAAGTTTG	TACAAAAAAG	CTGAACGAGA	AACGTAAAT	GATATAAATA
1381	TCAATATATT	AAATTAGATT	TTGCATAAAA	AACAGACTAC	ATAATACTGT	AAAACACAAC
1441	ATATCCAGTC	ACTATGGCGG	CCGCTAAGTT	GGCAGCATCA	CCCGACGCAC	TTTGCGCCGA
1501	ATAAATACCT	GTGACGGAAG	ATCACTTCGC	AGAATAAATA	AATCCTGGTG	TCCCTGTTGA
1561	TACCGGGAAG	CCCTGGGCCA	ACTTTTGGCG	AAAATGAGAC	GTTGATCGGC	ACGTAAGAGG
1621	TTCCAACCTT	CACCATAATG	AAATAAGATC	ACTACCGGGC	GTATTTTTTG	AGTTATCGAG
1681	ATTTTCAGGA	GCTAAGGAAG	CTAAAATGGA	GAAAAAATC	ACTGGATATA	CCACCGTTGA
1741	TATATCCCAA	TGGCATCGTA	AAGAACATTT	TGAGGCATTT	CAGTCAGTTG	CTCAATGTAC
1801	CTATAACCAG	ACCGTTCAGC	TGGATATTAC	GGCCTTTTTA	AAGACCGTAA	AGAAAAATAA
1861	GCACAAGTTT	TATCCGGCCT	TTATTCACAT	TCTTGCCCGC	CTGATGAATG	CTCATCCGGA
1921	ATTCCGTATG	GCAATGAAAG	ACGGTGAGCT	GGTGATATGG	GATAGTGTTT	ACCCTTGTTA
1981	CACCGTTTTC	CATGAGCAAA	CTGAAACGTT	TTTCATCGCTC	TGGAGTGAAT	ACCACGACGA
2041	TTTCCGGCAG	TTTCTACACA	TATATTTCGCA	AGATGTGGCG	TGTTACGGTG	AAAACCTGGC
2101	CTATTTCCCT	AAAGGGTTTA	TTGAGAATAT	GTTTTTCGTC	TCAGCCAATC	CCTGGGTGAG
2161	TTTCACCACT	TTTGATTTAA	ACGTGGCCAA	TATGGACAAC	TTCTTCGCCC	CCGTTTTTAC
2221	CATGGGCAAA	TATTATACGC	AAGGCGACAA	GGTGCTGATG	CCGCTGGCGA	TTCAGGTTCA
2281	TCATGCCGTC	TGTGATGGCT	TCCATGTCCG	CAGAATGCTT	AATGAATTAC	AACAGTACTG
2341	CGATGAGTGG	CAGGGCGGGG	CGTAATCTAG	AGGATCCGGC	TTACTAAAAG	CCAGATAACA
2401	GTATGCGTAT	TTGCGCGCTG	ATTTTTGCGG	TATAAGAATA	TATACTGATA	TGTATACCCG-

FIGURE 4B

2461 AAGTATGTCA AAAAGAGGTG TGCTATGAAG CAGCGTATTA CAGTGACAGT TGACAGCGAC
2521 AGCTATCAGT TGCTCAAGGC ATATATGATG TCAATATCTC CGGTCTGGTA AGCACAACCA
2581 TGCAGAATGA AGCCCGTCGT CTGCGTGCCG AACGCTGGAA AGCGGAAAAT CAGGAAGGGA
2641 TGGCTGAGGT CGCCCGGTTT ATTGAAATGA ACGGCTCTTT TGCTGACGAG AACAGGGACT
2701 GGTGAAATGC AGTTTAAGGT TTACACCTAT AAAAGAGAGA GCCGTTATCG TCTGTTTGTG
2761 GATGTACAGA GTGATATTAT TGACACGCCC GGGCGACGGA TGGTGATCCC CCTGGCCAGT
2821 GCACGTCTGC TGTCAGATAA AGTCTCCCGT GAACTTTACC CGGTGGTGCA TATCGGGGAT
2881 GAAAGCTGGC GCATGATGAC CACCGATATG GCCAGTGTGC CGGTCTCCGT TATCGGGGAA
2941 GAAGTGGCTG ATCTCAGCCA CCGCGAAAAT GACATCAAAA ACGCCATTAA CCTGATGTTT
3001 TGGGGAATAT AAATGTCAGG CTCCCTTATA CACAGCCAGT CTGCAGGTCT ACCATAGTGA
3061 CTGGATATGT TGTGTTTTAC AGTATTATGT AGTCTGTTTT TTATGCAAAA TCTAATTTAA
3121 TATATTGATA TTTATATCAT TTTACGTTTC TCGTTCAGCT TTCTTGATACA AAGTGGTTTTG
3181 ATGCGCCGTA AGTAAGTAAG ACGTCGAGCT CTAAGTAAGT AACGGCCGCC ACCGCGGTGG
3241 AGCTTTGGAC TTCTTCGCCA GAGGTTTGGT CAAGTCTCCA ATCAAGGTTG TCGGCTTGTC
3301 TACCTTGCCA GAAATTTACG AAAAGATGGA AAAGGGTCAA ATCGTTGGTA GATACGTTGT
3361 TGACACTTCT AAATAAGCGA ATTTCTTATG ATTTATGATT TTTATTATTA AATAAGTTAT
3421 AAAAAAATA AGTGATATAA AATTTTAAAG TGACTCTTAG GTTTTAAAC GAAAATTCCT
3481 ATTCTTGAGT AACTCTTCC TGTAGGTGAG GTTGCTTTCT CAGGTATAGC ATGAGGTGCG
3541 TCTTATTGAC CACACCTCTA CCGGCATGCC GAGCAAATGC CTGCAAATCG CTCCTCCATTT
3601 CACCCAATTG TAGATATGCT AACTCCAGCA ATGAGTTGAT GAATCTCGGT GTGATTTTTA
3661 TGTCTCAGGA GGACAATACC TGTTGTAATC GTTCTTCCAC ACGGATCCCA ATTCGCCCTA
3721 TAGTGAGTCG TATTACAATT CACTGCGCGT CGTTTTACAA CGTCGTGACT GGGAAAACCC
3781 TGGCGTTACC CAACTTAATC GCCTTGCAGC ACATCCCCCT TTCGCCAGCT GCGGTAATAG
3841 CGAAGAGGCC CGCACCAGTC GCCCTTCCCA ACAGTTGCGC AGCCTGAATG GCGAATGGAC
3901 GCGCCCTGTA GCGGCGCATT AAGCGCGCGG GGTGTGGTGG TTACGCGCAG CGTGACCGCT
3961 ACACTTGCCA GCGCCCTAGC GCGCGTCTCT TTCGCTTTCT TCCCTTCCTT TCTCGCCACG
4021 TTCGCCGGCT TTCCCCGTC AAGCTCTAAAT CGGGGGCTCC CTTTAGGGTT CCGATTTAGT
4081 GCTTACGGC ACCTCGACCC CAAAAAAGCT GATTAGGGTG ATGGTTCACG TAGTGGGCCA
4141 TCGCCCTGAT AGACGGTTTT TCGCCCTTGG ACCTTGGAGT CCACGTTCTT TAATAGTTGA
4201 CTCTTGTTCC AAAGTGAAC AACACTCAAC CCTATCTCGG TCTATTCTTT TGATTTATAA
4261 GGGATTTTGC CGATTTTCGGC CTATTGGTTA AAAAATGAGC TGATTTAACA AAAATTTAAC
4321 GCGAATTTTA ACAAATATT AACGTTTACA ATTTCTGAT GCGGTATTTT CTCCTTACGC
4381 ATCTGTGCGG TATTTACAC CGCATATCGA CCGGTGAGG AGAACTTCTA GTATATCCAC
4441 ATACCTAATA TTATTGCTT ATTAATAATG GAATCGGAAC AATTACATCA AAATCCACAT
4501 TCTCTTCAA ATCAATTGTC CTGTACTTCC TTGTTTATGT GTGTTCAAAA ACGTTATATT
4561 TATAGGATAA TTATACTCTA TTTCTCAACA AGTAATTGGT TGTTTGGCCG AGCGGTCTAA
4621 GGCGCCTGAT TCAAGAAATA TCTTGACCGC AGTTAACTGT GGAATACTC AGGTATCGTA
4681 AGATGCAAGA GTTCGAATCT CTTAGCAACC ATTATTTTTT TCCTCAACAT AACGAGAACA
4741 CACAGGGGCG CTATCGCAC GAATCAAAT CGATGACTGG AAATTTTTTG TTAATTTTCA
4801 AGGTGCGCTG ACGCATATAC CTTTTTCAAC TGAAAAATTG GGAGAAAAAG GAAAGGTGAG
4861 AGGCCGGAAC CGGCTTTTCA TATAGAATAG AGAAGCGTTC ATGACTAAAT GCTTGCATCA
4921 CAATACTTGA AGTTGACAAT ATTATTTAAG GACCTATTGT TTTTCCAAT AGGTGGTTAG
4981 CAATCGTCTT ACTTTCTAAC TTTTCTTACC TTTTACATTT CAGCAATATA TATATATATT
5041 TCAAGGATAT ACCATTCTAA TGTCTGCCCC TATGTCTGCC CTAAGAAGA TCGTCTTTTT
5101 GCCAGGTGAC CACGTTGGTC AAGAAATCAC AGCCGAAGCC ATTAAGGTTT TTAAGCTAT
5161 TTCTGATGTT CGTTCCAATG TCAAGTTCGA TTTCGAAAAT CATTTAATTG GTGGTGCTGC
5221 TATCGATGCT ACAGGTGTCC CACTTCCAGA TGAGGCGCTG GAAGCCTCCA AGAAGGTTGA
5281 TGCCGTTTTG TTAGGTGCTG TGGGTGGTCC TAAATGGGGT ACCGGTAGTG TTAGACCTGA
5341 ACAAGGTTTA CTAAAAATCC GTAAAGAAGT TCAATTGTAC GCCAACTTAA GACCATGTAA
5401 CTTTGCATCC GACTCTCTTT TAGACTTATC TCCAATCAAG CCACAATTTG CTAAAGGTAC
5461 TGACTTCGTT GTTGTCAGAG AATTAGTGGG AGGTATTTAC TTTGGTAAGA GAAAGGAAGA
5521 CGATGGTGAT GGTGTCGCTT GGGATAGTGA ACAATACACC GTTCCAGAAG TGCAAGAAT
5581 CACAAGAATG GCGGCTTTCA TGGCCCTACA ACATGAGCCA CCATTGCCTA TTTGGTCTTT
5641 GGATAAAGCT AATGTTTTGG CCTCTTCAAG ATTATGGAGA AAAACTGTGG AGGAAACCAT
5701 CAAGAACGAA TTCCCTACAT TGAAGGTTCA ACATCAATTG ATTGATTCTG CCGCCATGAT
5761 CCTAGTTAAG AACCCAACCC ACCTAAATGG TATTATAATC ACCAGCAACA TGTTTGGTGA
5821 TATCATCTCC GATGAAGCCT CCGTTATCCC AGGTTCCTTG GGTGTGTTGC CATCTGCGTC
5881 CTTGGCCTCT TTGCCAGACA AGAACACCGC ATTTGGTTTG TACGAACCAT GCCACGGTTC-

5941 TGCTCCAGAT TTGCCAAAGA ATAAGGTTGA CCCTATCGCC ACTATCTTGT CTGCTGCAAT
6001 GATGTTGAAA TTGTCATTGA ACTTGCCTGA AGAAGGTAAG GCCATTGAAG ATGCAGTTAA
6061 AAAGGTTTTG GATGCAGGTA TCAGAACTGG TGATTTAGGT GGTTCCAACA GTACCACCGA
6121 AGTCGGTGAT GCTGTCGCCG AAGAAGTTAA GAAAATCCTT GCTTAAAAAG ATTCTCTTTT
6181 TTTATGATAT TTGTACATAA ACTTTTATAA TGAAATTCAT AATAGAAAACG ACACGAAATT
6241 ACAAAATGGA ATATGTTTCAT AGGGTAGACG AAACATATA CGCAATCTAC ATACATTTAT
6301 CAAGAAGGAG AAAAAGGAGG ATAGTAAAGG AATACAGGTA AGCAAATTGA TACTAATGGC
6361 TCAACGTGAT AAGGAAAAAG AATTGCACTT TAACATTAAT ATTGACAAGG AGGAGGGCAC
6421 CACACAAAAA GTTAGGTGTA ACAGAAAATC ATGAAACTAC GATTCCCTAAT TTGATATTGG
6481 AGGATTTTCT CTAAAAAAA AAAAATACAA CAAATAAAAA ACACTCAATG ACCTGACCAT
6541 TTGATGGAGT TTAAGTCAAT ACCTTCTTGA ACCATTTCCTC ATAATGGTGA AAGTTCCCTC
6601 AAGAATTTTA CTCTGTCAGA AACGGCCTTA CGACGTAGTC GATATGGTGC ACTCTCAGTA
6661 CAATCTGCTC TGATGCCGCA TAGTTAAGCC AGCCCCGACA CCCGCCAACA CCCGCTGACG
6721 CGCCCTGACG GGCTTGCTCG CTCCCGGCAT CCGCTTACAG ACAAGCTGTG ACCGTCTCCG
6781 GGAGCTGCAT GTGTCAGAGG TTTTCACCGT CATCACCGAA ACGCGCGAGA CGAAAGGGCC
6841 TCGTGATACG CCTATTTTGA TAGGTTAATG TCATGATAAT AATGGTTTCT TAGGACGGAT
6901 CGCTTGCCCTG TAACCTACAC GCGCCTCGTA TCTTTTAATG ATGGAATAAT TTGGGAATTT
6961 ACTCTGTGTT TATTTATTTT TATGTTTGT ATTTGGATT TAGAAAAGTAA ATAAAGAAGG
7021 TAGAAGAGTT ACGGAATGAA GAAAAAAA TAAACAAAGG TTTAAAAAT TTCAACAAAA
7081 AGCGTACTTT ACATATATAT TTATTAGACA AGAAAAGCAG ATTAATAGTA TATACATTCTG
7141 ATTAACGATA AGTAAATGT AAAATCACAG GATTTTCGTG TGTGGTCTTC TACACAGACA
7201 AGATGAAACA ATTCGGCATT AATACCTGAG AGCAGGAAGA GCAAGATAAA AGGTAGTATT
7261 TGTTGGCGAT CCCCCTAGAG TCTTTTACAT CTTCGGAATA CAAAAACTAT TTTTCTTTTA
7321 ATTTCTTTTT TTTTCTTTA TTTTAAATTT ATATATTTAT ATTAATAAAT TTAAATTATA
7381 ATTATTTTTA TAGCACGTGA TGAAAAGGAC CCAGGTGGCA CTTTTCGGGG AAATGTGCGC
7441 GGAACCCCTA TTTGTTTATT TTTCTAAATA CATTCAAATA TGTATCCGCT CATGAGACAA
7501 TAACCTGAT AAATGCTTCA ATAATCTGCA GCTCTGGCCC GTGTCTCAAA ATCTCTGATG
7561 TTACTTTGCA CAAGATAAAA ATATATCATC ATGAACAATA AAACGTCTG CTTACATAAA
7621 CAGTAATACA AGGGGTGTTA TGAGCCATAT TCAACGGGAA ACGTCTTGCT GGAGCCCGCG
7681 ATTAAATTCC AACATGGATG CTGATTTATA TGGGTATAAA TGGGCTCGCG ATAATGTGCG
7741 GCAATCAGGT GCGACAATCT TTCGATTGTA TGGGAAGCCC GATGCGCCAG AGTTGTTTCT
7801 GAAACATGGC AAAGGTAGCG TTGCCAATGA TGTTACAGAT GAGATGGTCA GACTAACTG
7861 GCTGACGGAA TTTATGCCTC TTCCGACCAT CAAGCATTTT ATCCGTACTC CTGATGATGC
7921 ATGGTTACTC ACCACTGCGA TCCGCGGGAA AACAGCATT CAGGTATTAG AAGAATATCC
7981 TGATTACAGT GAAAATATTG TTGATGCGCT GGCAGTGTTC CTGCGCCGGT TGCATTGAT
8041 TCCTGTTTGT AATTGTCCTT TTAACAGCGA TCGCGTATTT CGTCTCGCTC AGGCGCAATC
8101 ACGAATGAAT AACGGTTTGG TTGATGCGAG TGATTTTGAT GACGAGCGTA ATGGCTGGCC
8161 TGTTGAACAA GTCTGGAAAG AAATGCATAC GCTTTTGCCA TTCTCACCAG ATTCAGTCGT
8221 CACTCATGGT GATTTCTCAC TTGATAACCT TATTTTGTAC GAGGGGAAAT TAATAGGTTG
8281 TATTGATGTT GGACGAGTCG GAATCGCAGA CCGATACCAG GATCTTGCCA TCCTATGGAA
8341 CTGCCTCGGT GAGTTTCTC CTTCATTACA GAAACGGCTT TTTCAAAAAT ATGGTATTGA
8401 TAATCCTGAT ATGAATAAAT TGCAGTTTCA TTTGATGCTC GATGAGTTT TCTAATCAGA
8461 ATTGGTTAAT TGGTTGTAAC ACTGGCAGAG CATTACGCTG ACTTGACGGG ACGGCGCATG
8521 ACCAAAATCC CTTAACGTGA GTTTTCGTTT CACTGAGCGT CAGACCCCGT AGAAAAGATC
8581 AAAGGATCTT CTTGAGATCC TTTTCTCTG CCGGTAATCT GCTGCTTGCA AACAAAAAAA
8641 CCACCGCTAC CAGCGGTGGT TTGTTTGCCG GATCAAGAGC TACCAACTCT TTTTCCGAAG
8701 GTAACCTGGT TCAGCAGAGC GCAGATACCA AATACTGTCC TTCTAGTGA GCCGTAGTTA
8761 GGCCACCACT TCAAGAACTC TGTAGCACCG CCTACATACC TCGTCTGCT AATCCTGTTA
8821 CCAGTGGCTG CTGCCAGTGG CGATAAGTCG TGTCTTACCG GGTGGACTC AAGACGATAG
8881 TTACCGGATA AGGCGCAGCG GTCGGGCTGA ACGGGGGGTT CGTGCCACACA GCCCAGCTTG
8941 GAGCGAACGA CCTACACCGA ACTGAGATAC CTACAGCGTG AGCATTGAGA AAGCGCCACG
9001 CTTCCCGAAG GGAGAAAGGC GGACAGGTAT CCGGTAAGCG GCAGGGTCCG AACAGGAGAG
9061 CGCACGAGGG AGCTTCCAGG GGGGAACGCC TGGTATCTTT ATAGTCCTGT CGGGTTTTCG
9121 CACCTCTGAC TTGAGCGTCG ATTTTGTGTA TGCTCGTCAG GGGGCGCGAG CCTATGGAAA
9181 AACGCCAGCA ACGCGGCCCT TTTACGGTTC CTGGCCTTTT GCTGGCCTTT TGCTCACATG
9241 TTCTTTCTCTG CGTTATCCCC TGATTCTGTG GATAACCGTA TTACCGCCTT TGAGTGAGCT
9301 GATACCGCTC GCCGCAGCCG AACGACCGAG CGCAGCGAGT CAGTGAGCGA GGAAGCGGAA
9361 GAGCGCCCAA TACGCAAACC GCCTCTCCCC GCGCGTTGGC CGATTCAATTA ATGCAGCTGG-

FIGURE 4D

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9421 CACGACAGGT TTCCCGACTG GAAAGCGGGC AGTGAGCGCA ACGCAATTAA TGTGAGTTAC
9481 CTCACCTCATT AGGCACCCCA GGCTTTACAC TTTATGCTTC CGGCTCCTAT GTTGTGTGGA
9541 ATTGTGAGCG GATAACAATT TCACACAGGA AACAGCTATG ACCATGATTA CGCCAAGCTC
9601 GGAATTAACC CTCACTAAAG GGAACAAAAG CTGGTACCGA TCCCGAGCTT TGCAAATTAA
9661 AGCCTTCGAG CGTCCCAAAA CCTTCTCAAG CAAGGTTTTC AGTATAATGT TACATGCGTA
9721 CACGCGTCTG TACAGAAAAA AAAGAAAAAT TTGAAATATA AATAACGTTT TTAATACTAA
9781 CATAACTATA AAAAAATAAA TAGGGACCTA GACTTCAGGT TGTCTAACTC CTTCTTTTTC
9841 GGTTAGAGCG GATGTGGGGG GAGGGCGTGA ATGTAAGCGT GACATACTA ATTACATGAT
9901 ATCGACAAAG GAAAAGGGGC CTGTTTACTC ACAGGCTTTT TTCAAGTAGG TAATTAAGTC
9961 GTTCTGTCT TTTTCCTTCT TCAACCCACC AAAGGCCATC TTGGTACTTT TTTTTTTTTT
10021 TTTTTTTTTT TTTTTTTTTT TTTTTTTTTT TTTTTTTTTT TTTTTTTTTT TTTTTTTTTT
10081 TTTTTTTTTT TTTTTTTTTT TCATAGAAAT AATACAGAAG TAGATGTTGA ATTAGATTAA
10141 ACTGAAGATA TATAATTTAT TGGAAAATAC ATAGAGCTTT TTGTTGATGC GCTTAAGCGA
10201 TCAATTCAAC AACACCACCA GCAGCTCTGA TTTTTTCTTC AGCCAACCTG GAGACGAATC
10261 TAGCTTTGAC GATAACTGGA ACATTTGGAA TTCTACCCTT ACCCAAGATC TTACCGTAAC
10321 CGGCTGCCAA AGTGTCAATA ACTGGAGCAG TTTCTTAGA AGCAGATTTC AAGTATTGGT
10381 CTCTCTTGTC TTCTGGGATC AATGTCCACA ATTTGTCCAA GTTCAAGACT GGCTTCCAGA
10441 AATGAGCTTG TTGCTTGTGG AAGTATCTCA TACCAACCTT ACCGAAATAA CCTGGATGGT
10501 ATTTATCCAT GTTAATCTG TGGTGATGTT GACCACCGGC CATACTCTA CCACCGGGGT
10561 GCTTTCTGTG CTTACCGATA CGACCTTTAC CGGCTGAGAC GTGACCTCTG TGCTTTCTAG
10621 TCTTAGTGAA TCTGGAAGGC ATTCTTGATT AGTTGGATGA TTGTTCTGGG ATTTAATGCA
10681 AAAATCACCT AAGAAGGAAA ATCAACGGAG AAAGCAAACG CCATCTTAAA TATACGGGAT
10741 ACAGATGAAA GGGTTTGAAC CTATCTGGAA AATAGCATT AACAAGCGAA AAAGTGCAG
10801 GAAAATTGTT TGCGTCTCTG CGGGCTATTC ACGCGCCAGA GGAAAATAGG AAAAAATAACA
10861 GGGCATTAGA AAAATAATTT TGATTTTGGT AATGTGTGGG TCCTGGTGTA CAGATGTTAC
10921 ATTGGTTACA GTACTCTTGT TTTTGCTGTG TTTTTCGATG AATCTCCAAA ATGGTTGTTA
10981 GCACATGGAA GAGTCACCGA TGCTAAGTTA TCTCTATGTA AGCTACGTGG CGTGACTTTT
11041 GATGAAGCCG CACAAGAGAT ACAGGATTGG CAACTGCAAA TAGAATCTGG GGATCCCCC
11101 TCGAGATCCG GGATCGAAGA AATGATGGTA AATGAAATAG GAAATCAAGG AGCATGAAGG
11161 CAAAAGACAA ATATAAGGGT CGAACGAAAA ATAAAGTGAA AAGTGTTGAT ATGATGTATT
11221 TGGCTTTGCG GCGCCGAAAA AACGAGTTTA CGCAATTGCA CAATCATGCT GACTCTGTGG
11281 CGGACCCGCG CTCTTGCCGG CCCGGCGATA ACGCTGGGCG TGAGGCTGTG CCCGGCGGAG
11341 TTTTTTGCGC CTGCATTTTC CAAGGTTTAC CCTGCGCTAA GGGGCGAGAT TGGAGAAGCA
11401 ATAAGAATGC CGGTTGGGGT TGCGATGATG ACGACCACGA CAACTGGTGT CATTATTTAA
11461 GTTGCCGAAA GAACCTGAGT GCATTTGCAA CATGAGTATA CTAGAAGAAT GAGCCAAGAC
11521 TTGCGAGACG CGAGTTTGCC GGTGGTGCGA ACAATAGAGC GACCATGACC TTGAAGGTGA
11581 GACGCGCATA ACCGCTAGAG TACTTTGAAG AGGAAACAGC AATAGGGTTG CTACCAGTAT
11641 AAATAGACAG GTACATACAA CACTGGAAAT GGTGTCTGT TTGAGTACGC TTTCAATTCA
11701 TTTGGGTGTG CAC

FIGURE 415

Figure 42A:

pDEST22

2-Hybrid Vector with
Activation Domain

657 acg cac act act ctc taa tga gca acg gta tac ggc ctt cct tcc agt tac
tgc gtg tga tga gag att act cgt tgc cat atg ccg gaa gga agg tca atg

708 ttg aat ttg aaa taa aaa aag ttt gcc gct ttg cta tca agt ata aat aga
aac tta aac ttt att ttt ttc aaa cgg cga aac gat agt tca tat tta tct

759 cct gca att att aat ctt ttg ttt cct cgt cat tgt tet cgt tcc ctt tct
gga cgt taa taa tta gaa aac aaa gga gca gta aca aga gca agg gaa aga

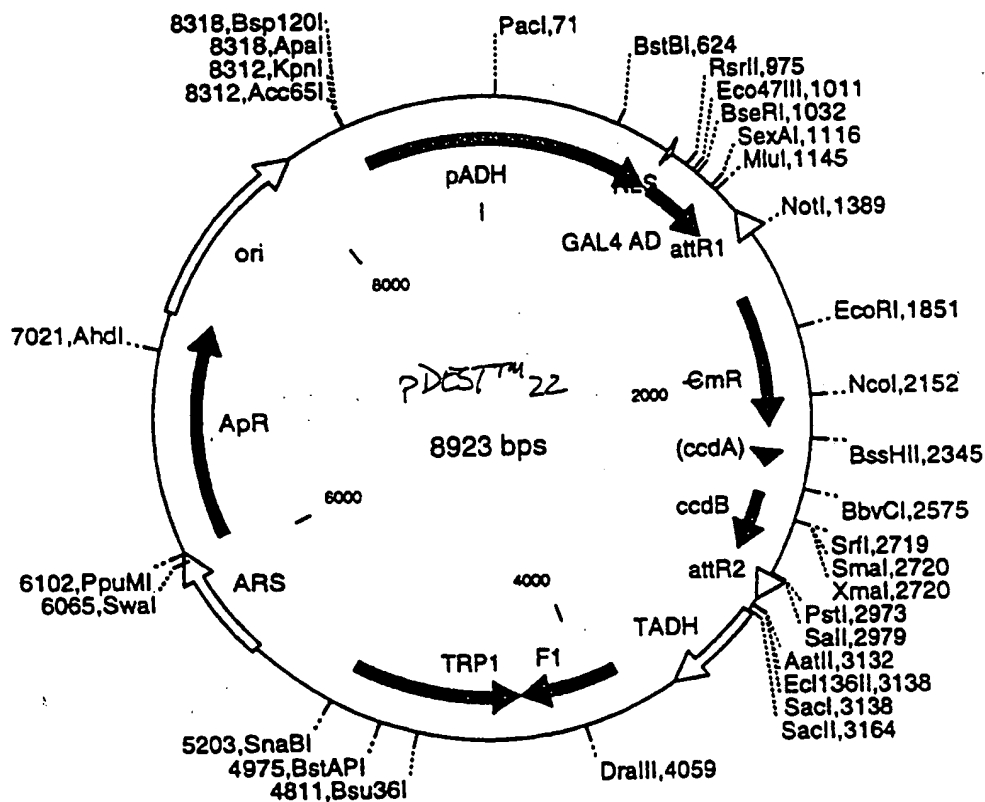
810 ~~ccc ttg ttt ctt ttc gtc cat att tca agc tat acc aag cat aca atc~~
~~agg aac aaa gaa aaa gac gtg tta taa agt tgc ata tgg ttc gta tgt tag~~

861 ~~aac tcc aag ctt atg ccc aag aag aag cgg aag gtc tgc agc ggc gcc aat~~
~~ttg agg ttc gaa tac ggg ttc ttc ttc gcc ttc cag agc tgc cgg ttc~~

1218 gaa gat acc cca cca aac cca aaa aaa gag ggt ggg tgc aat caa **aca agt**
ctt cta tgg ggt ggt ttg ggt ttt ttt ctc cca ccc agc tta gtt **tgt tca**

1269 **LYKKAKRR**
ttg tac aaa aaa gct gaa cga gaa acg taa a
aac atg ttt ttt cga ctt gct ctt tgc att t

ADH Promoter
Gal4-AD
Start Translation
D G G S N Q T S
Int



pDEST22 8923 bp

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
904..1248	GAL4 AD
1388..1264	attR1
1638..2297	CmR
2417..2501	inactivated ccdA
2639..2944	ccdB
2985..3109	attR2
3831..4318	f1 (f1 intergenic region)
4334..5176	TRP1
6110..7194	ampR
8344..866	pADH (yeast ADH promoter)

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1  TTCATTTGGG TGTGCACTTT ATTATGTTAC AATATGGAAG GGAACCTTTAC ACTTCTCCTA
61  TGCACATATA TTAATTAAAG TCCAATGCTA GTAGAGAAGG GGGGTAACAC CCCTCCGCGC
121 TCTTTTCCGA TTTTTTCTA AACCGTGGAA TATTTCCGAT ATCCTTTTGT TGTTCGCGG
181 TGTACAATAT GGACTTCCTC TTTTCTGGCA ACCAAACCCA TACATCGGGA TTCCTATAAT
241 ACCTTCGTTG GTCTCCCTAA CATGTAGGTG GCGGAGGGGA GATATACAAT AGAACAGATA
301 CCAGACAAGA CATAATGGGC TAAACAAGAC TACACCAATT ACATGCCTC ATTGATGGTG
361 GTACATAACG AACTAATACT GTAGCCCTAG ACTTGATAGC CATCATCATA TCGAAGTTTC
421 ACTACCCTTT TTCCATTTGC CATCTATTGA AGTAATAATA GGCGCATGCA ACTTCTTTTC
481 TTTTTTTTTT TTTTCTCTCT CCCCCGTTGT TGTCTCACCA TATCCGCAAT GACAAAAAAA
541 ATGATGGAAG AACTAAAGG AAAAAATTAA CGACAAAGAC AGCACCAACA GATGTCGTTG
601 TTCCAGAGCT GATGAGGGGT ATCTTCGAAC ACACGAAACT TTTTCCTTCC TTCATTCACG
661 CACACTACTC TCTAATGAGC AACGGTATAC GGCCTTCCTT CCAGTTACTT GAATTTGAAA
721 TAAAAAAGT TTGCCGCTTT GCTATCAAGT ATAAATAGAC CTGCAATTAT TAATCTTTTG
781 TTTCTCTGTC ATTGTTCTCG TTCCCTTTCT TCCTTGTTTC TTTTCTGCA CAATATTTCA
841 AGCTATACCA AGCATACAAT CAACTCCAAG CTTATGCCCA AGAAGAAGCG GAAGGTCTCG
901 AGCGGCGCCA ATTTTAATCA AAGTGGGAAT ATTGTGATA GCTCATTGTC CTTCACTTTC
961 ACTAACAGTA GCAACGGTCC GAACCTCATA ACAACTCAAA CAAATTCTCA AGCGCTTTCA
1021 CAACCAATTG CCTCCTCTAA CGTTCATGAT AACTTCATGA ATAATGAAAT CACGGCTAGT
1081 AAAATTGATG ATGGTAATAA TTCAAAACCA CTGTCACCTG GTTGGACGGA CCAAACGCG
1141 TATAACGCGT TTGGAATCAC TACAGGGATG TTTAATACCA CTACAATGGA TGATGTATAT
1201 AACTATCTAT TCGATGATGA AGATACCCCA CCAAACCCAA AAAAAGAGGG TGGGTGCAAT
1261 CAAACAAGTT TGTACAAAAA AGCTGAACGA GAAACGTAAA ATGATATAAA TATCAATATA
1321 TTAAATTAGA TTTTGCATAA AAAACAGACT ACATAATACT GTAAAACACA ACATATCCAG
1381 TCATATGGC GGCCGCTAAG TTGGCAGCAT CACCCGACGC ACTTTGCGCC GAATAAATAC
1441 CTGTGACGGA AGATCACTTC GCAGAATAAA TAAATCCTGG TGTCCCTGTT GATACCGGGA
1501 AGCCCTGGGC CAACTTTTGG CGAAAATGAG ACGTTGATCG GCACGTAAGA GGTTCCAACT
1561 TTCACCATAA TGAAATAAGA TCACTACCGG GCGTATTTTT TGAGTTATCG AGATTTTCAG
1621 GAGCTAAGGA AGCTAAAATG GAGAAAAAAA TCACTGGATA TACCACCGTT GATATATCCC
1681 AATGGCATCG TAAAGAACAT TTTGAGGCAT TTCAGTCAGT TGCTCAATGT ACCTATAACC
1741 AGACCGTTCA GCTGGATATT ACGGCCTTTT TAAAGACCGT AAAGAAAAAT AAGCACAAGT
1801 TTTATCCGGC CTTTATTCAC ATTCTTGCCC GCCTGATGAA TGCTCATCCG GAATTCGGTA
1861 TGGCAATGAA AGACGGTGAG CTGGTGATAT GGGATAGTGT TCACCCTTGT TACACCGTTT
1921 TCCATGAGCA AACTGAAACG TTTTCATCGC TCTGGAGTGA ATACCACGAC GATTTCCGGC
1981 AGTTTCTACA CATATATTCG CAAGATGTGG CGTGTTACGG TGAAAACCTG GCCTATTTCC
2041 CTAAAGGGTT TATTGAGAAT ATGTTTTTTC TCTCAGCCAA TCCCTGGGTG AGTTTCACCA
2101 GTTTTGATTT AAACGTGGCC AATATGGACA ACTTCTTCGC CCCCCTTTTC ACCATGGGCA
2161 AATATTATAC GCAAGGCGAC AAGGTGCTGA TGCCGCTGGC GATTCAAGTT CATCATGCCG
2221 TCTGTGATGG CTTCCATGTC GGCAGAATGC TTAATGAATT ACAACAGTAC TGCGATGAGT
2281 GGCAGGGCGG GCGTAATCT AGAGGATCCG GCTTACTAAA AGCCAGATAA CAGTATGCGT
2341 ATTTGCGCGC TGATTTTTCG GGTATAAGAA TATATACTGA TATGTATACC CGAAGTATGT
2401 CAAAAGAGG TGTGCTATGA AGCAGCGTAT TACAGTGACA GTTGACAGCG ACAGCTATCA
2461 GTTGCTCAAG GCATATATGA TGTCAATATC TCCGGTCTGG TAAGCACAAC CATGCAGAAT
2521 GAAGCCCGTC GTCTGCGTGC CGAACGCTGG AAAGCGGAAA ATCAGGAAGG GATGGCTGAG-

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FIGURE 42B

2581 GTCGCCCCGGT TTATTGAAAT GAACGGCTCT TTTGCTGACG AGAACAGGGA CTGGTGAAAT
2641 GCAGTTTAAAG GTTTACACCT ATAAAAGAGA GAGCCGTTAT CGTCTGTTT3 TGGATGTACA
2701 GAGTGATATT ATTGACACGC CCGGGCGACG GATGGTGATC CCCCTGGCCA GTGCACGTCT
2761 GCTGTCAGAT AAAGTCTCCC GTGAACTTTA CCCGGTGGTG CATATCGG33 ATGAAAGCTG
2821 GCGCATGATG ACCACCGATA TGGCCAGTGT GCCGGTCTCC GTTATCGGG3 AAGAAGTGGC
2881 TGATCTCAGC CACCGCGAAA ATGACATCAA AAACGCCATT AACCTGATGT TCTGGGGAAT
2941 ATAAATGTCA GGCTCCCTTA TACACAGCCA GTCTGCAGGT CGACCATAGT GACTGGSATAT
3001 GTTGTGTTTT ACAGTATTAT GTAGTCTGTT TTTTATGCAA AATCTAATTT AATATATTGA
3061 TATTTATATC ATTTTACGTT TCTCGTTCAG CTTTCTTGTA CAAAGTGGTT TGATGGCCGC
3121 TAAGTGTATA AGACGTCGAG CTCTAAGTAA GTAACGGCCG CCACCGCGGT GGAGCTTTGG
3181 ACTTCTTTCGC CAGAGGTTTG GTCAAGTCTC CAATCAAGGT TGTCGGCTTG TCTACCTTGC
3241 CGAAAATTTA CGAAAAGATG GAAAAGGGTC AAATCGTTGG TAGATACGTT GTTGACACTT
3301 CTAAATAAGC GAATTTCTTA TGATTTATGA TTTTATTAT TAAATAAGTT ATAAAAAATA
3361 TAAGTGTATA CAAATTTTAA AGTGAATCTT AGGTTTTTAA ACGAAAATTC TTATCTTGA
3421 GTAATCTTTT CCTGTAGGTC AGGTTGCTTT CTCAGGTATA GCATGAGGTC GCTCTTATTG
3481 ACCACACCTC TACCGGCATG CCGAGCAAAT GCCTGCAAAT CGCTCCCCAT TTCACCCAAT
3541 TGATGATATG CTAATCCAG CAATGAGTTG ATGAATCTCG GTGTGTATTT TATGTCCTCA
3601 GAGGACAATA CCTGTTGTAA TCGTTCTTCC ACACGGATCC CAATTCGCCC TATAGTGAGT
3661 CGTATTACAA TTCACTGGCC GTCGTTTTAC AACGTCTGTA CTGGGAAAAC CCTGGCGTTA
3721 CCCAACTTAA TCGCCTTGCA GCACATCCCC CTTTCGCCAG CTGGCGTAAT AGCGAAGAGG
3781 CCCGCACCGA TCGCCCTTCC CAACAGTTGC GCAGCCTGAA TGGCGAATGG ACGCGCCCTG
3841 TAGCGGCGCA TTAAGCGCGG CCGGTGTGGT GGTACGCGC AGCGTGACCG CTACACTTGC
3901 CAGCGCCCTA GCGCCCGCTC CTTTCGCTTT CTTCCCTTCC TTTCTCGCCA CGTTCGCGCG
3961 CTTTCCCCGT CAAGCTCTAA ATCGGGGGCT CCCTTTAGGG TTCCGATTTA GTGCTTTACG
4021 GCACCTCGAC CCCAAAAAAC TTGATTAGGG TGATGGTTCA CGTAGTGGGC CATCGCCCTG
4081 ATAGACGGTT TTTGCCCCCT TGACGTTGGA GTCCACGTTT TTTAATAGTG GACTCTTGTT
4141 CCAAACCTGGA ACAACACTCA ACCCTATCTC GGTCATTCT TTTGATTAT AAGGGATTTT
4201 GCCGATTTCT GCCTATTGGT TAAAAAATGA GCTGATTTAA CAAAAATTTA ACGCGAATTT
4261 TAACAAAATA TTAACGTTTA CAATTTCTTG ATGCGGTATT TTCTCCTTAC GCATCTGTGC
4321 GGTATTTTAC ACCGAGGCA AGTGACAAA CAATACTTAA ATAAATACTA CTCAGTAATA
4381 ACCTATTTCT TAGCATTTTT GACGAAATTT GCTATTTTGT TAGAGTCTTT TACACCTTT
4441 GTCTCCACAC CTCCGCTTAC ATCAACACCA ATAACGCCAT TTAATCTAAG CGCATCACCA
4501 ACATTTTCTG GCGTCAGTCC ACCAGCTAAC ATAAAAATGA AGCTTTTCGGG GCTCTCTTGC
4561 CTTCCAACCC AGTCAGAAAT CGAGTTCCAA TCCAAAAGTT CACCTGTCCC ACCTGCTTCT
4621 GAATCAAACA AGGGAATAAA CGAATGAGGT TTCTGTGAAG CTGCACTGAG TAGTATGTTG
4681 CAGTCTTTTG GAAATACGAG TCTTTTAATA ACTGGCAAAC CGAGGAATC TTGGTATTCT
4741 TGCCACGACT CATCTCCATG CAGTTGGACG ATATCAATGC CGTAATCATT GACCAGAGCC
4801 AAAACATCCT CCTTAGGTTG ATTACGAAAC ACGCCAACCA AGTATTTCCG AGTGCCTGAA
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5221 ATTTTCAAT AAAGAATATC TTCCACTACT GCCATCTGGC GTCATAACTG CAAAGTACAC
5281 ATATATTACG ATGCTGTCTA TTAAATGCTT CCTATATTAT ATATATAGTA ATGTCGTTTTA
5341 TGGTGCACTC TCAGTACAAT CTGCTCTGAT GCCGCATAGT TAAGCCAGCC CCGACACCCG
5401 CCAACACCCG CTGACGCGCC CTGACGGGCT TGTCTGCTCC CGGCATCCGC TTACAGACAA
5461 GCTGTGACCG TCTCCGGGAG CTGCATGTGT CAGAGGTTTT CACCGTCATC ACCGAAACGC
5521 GCGAGACGAA AGGGCCTCGT GATACGCCTA TTTTATAGG TTAATGTCAT GATAATAATG
5581 GTTCTTTAGG ACGGATCGCT TTACACGCGC CTCGTATCTT TTAATGATGG
5641 AATAATTTGG GAATTTACTC TGTGTTTATT TATTTTATG TTTTGTATTG GGATTTTAGA
5701 AAGTAAATAA AGAAGGTAGA AGAGTTACGG AATGAAGAAA AAAAAATAAA CAAAGGTTTTA
5761 AAAAATTTCA AAAAAAGCG TACTTTACAT ATATATTTAT TAGACAAGAA AAGCAGATTA
5821 AATAGATATA CATTCGATTA ACGATAAGTA AAATGTAAAA TCACAGGATT TTCGTGTGTG
5881 GTCTTCTACA CAGACAAGAT GAAACAATTC GGCATTAATA CCTGAGAGCA GGAAGAGCAA
5941 GATAAAAGGT AGTATTGTG GCGCATCCCC CTAGAGTCTT TTACATCTTC GGAAAAACAA
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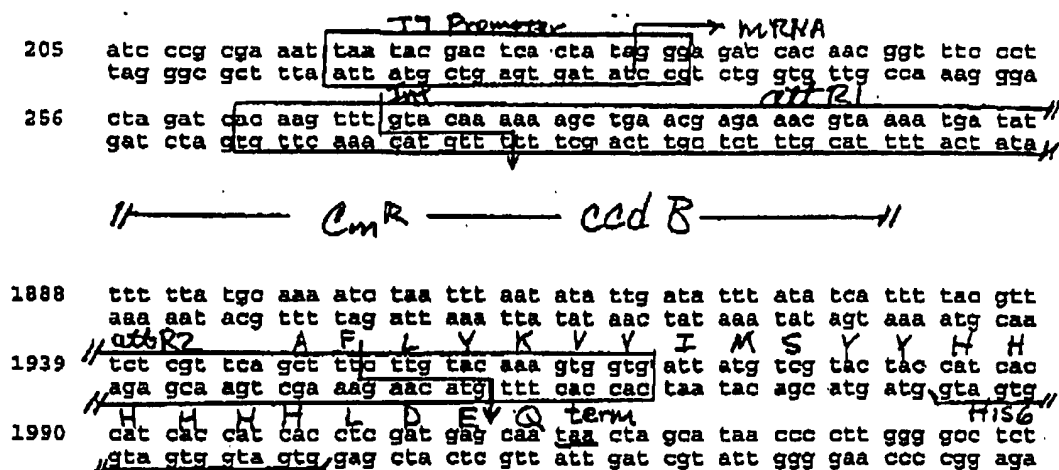
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6121 TCGGGGAAAT GTGCGCGGAA CCCCTATTTG TTTATTTTTC TAAATACATT CAAATATGTA
6181 TCCGCTCATG AGACAATAAC CCTGATAAAT GCTTCAATAA TATTGAAAAA GGAAGAGTAT
6241 GAGTATTCAA CATTTCCGTG TCGCCCTTAT TCCCTTTTTT GCGGCATTTT GCCTTCCTGT
6301 TTTTGCTCAC CCAGAAACGC TGGTGAAAGT AAAAGATGCT GAAGATCAGT TGGGTGCACG
6361 AGTGGGTAC ATCGAACTGG ATCTCAACAG CGGTAAGATC CTTGAGAGTT TTCGCCCCGA
6421 AGAACGTTTT CCAATGATGA GCACTTTTAA AGTTCTGCTA TGTGGCGCGG TATTATCCCG
6481 TATTGACGCC GGGCAAGAGC AACTCGGTG CCGCATACAC TATTCTCAGA ATGACTTGGT
6541 TGAGTACTCA CCAGTCACAG AAAAGCATCT TACGGATGGC ATGACAGTAA GAGAATTATG
6601 CAGTGCTGCC ATAACCATGA GTGATAACAC TGCGGCCAAC TTACTTCTGA CAACGATCGG
6661 AGGACCGAAG GAGCTAACCG CTTTITTTTCA CAACATGGGG GATCATGTAA CTCGCCTTGA
6721 TCGTTGGGAA CCGGAGCTGA ATGAAGCCAT ACCAAACGAC GAGCGTGACA CCACGATGCC
6781 TGTAGCAATG GCAACAACGT TCGCAAACT ATTAAGTGGC GAAGTACTTA CTCTAGCTTC
6841 CCGGCAACAA TTAATAGACT GGATGGAGGC GGATAAAGTT GCAGGACCAC TTCTGCGCTC
6901 GGCCCTTCCG GCTGGCTGGT TTATTGCTGA TAAATCTGGA GCCGGTGAGC GTGGGTCTCG
6961 CGGTATCATT GCAGCACTGG GGCCAGATGG TAAGCCCTCC CGTATCGTAG TTATCTACAC
7021 GACGGGCAGT CAGGCAACTA TGGATGAACG AAATAGACAG ATCGCTGAGA TAGGTGCCTC
7081 ACTGATTAAG CATTGGTAAC TGTCAGACCA AGTTTACTCA TATATACTTT AGATTGATTT
7141 AAAACTTCAT TTTTAATTTA AAAGGATCTA GGTGAAGATC CTTTTTGATA ATCTCATGAC
7201 CAAAATCCCT TAACGTGAGT TTTTCGTCCA CTGAGCGTCA GACCCCGTAG AAAAGATCAA
7261 AGGATCTTCT TGAGATCCTT TTTTCTGCG CGTAATCTGC TGCTTGCAA CAAAAAACC
7321 ACCGCTACCA GCGGTGGTTT GTTTGCCGGA TCAAGAGCTA CCAACTCTTT TTCCGAAGGT
7381 AACTGCTTC AGCAGAGCGC AGATACCAA TACTGTCCTT CTAGTGTAGC CGTAGTTAGG
7441 CCACCACTTC AAGAACTCTG TAGCACCGCC TACATACCTC GCTCTGCTAA TCCTGTTACC
7501 AGTGGCTGCT GCCAGTGGCG ATAAGTCGTG TCTTACCGGG TTGGACTCAA GACGATAGTT
7561 ACCGGATAAG GCGCAGCGGT CGGGCTGAAC GGGGGGTTG TGCACACAGC CCAGCTTGGA
7621 GCGAACGACC TACACCGAAC TGAGATACCT ACAGCGTGAG CATTGAGAAA GCGCCACGCT
7681 TCCCGAAGGG AGAAAGGCGG ACAGGTATCC GGTAAGCGGC AGGGTCGGAA CAGGAGACCG
7741 CACGAGGGAG CTTCCAGGGG GGAACGCCCTG GTATCTTTAT AGTCTGTGCG GGTTCGCCA
7801 CCTCTGACTT GAGCGTCGAT TTTTGTGATG CTCGTGAGG GGGCCGAGCC TATGGA AAAA
7861 CGCCAGCAAC GCGGCCCTTT TACGGTTCCT GGCCTTTTGC TGGCCTTTTG CTCACATGTT
7921 CTTTCTGCG TTATCCCCTG ATTCTGTGGA TAACCGTATT ACCGCCTTTG AGTGAGCTGA
7981 TACCGCTCGC CGCAGCCGAA CGACCGAGCG CAGCGAGTCA GTGAGCGAGG AAGCGGAAGA
8041 GCGCCCAATA CGCAAACCGC CTCTCCCCGC GCGTTGGCCG ATTCATTAAT GCAGCTGGCA
8101 CGACAGGTTT CCCGACTGGA AAGCGGGCAG TGAGCGCAAC GCAATTAATG TGAGTTACCT
8161 CACTCATTAG GCACCCCAAG CTTTACACTT TATGCTTCCG GCTCCTATGT TGTGTGGAAT
8221 TGTGAGCGGA TAACAATTTT ACACAGGAAA CAGCTATGAC CATGATTACG CCAAGCTCGG
8281 AATTAACCTT CACTAAAGGG AAAAAAGCT GGGTACCGGG CCCCCCTCG AGATCCGGGA
8341 TCGAAGAAAT GATGGTAAAT GAAATAGGAA ATCAAGGAGC ATGAAGGCAA AAGACAAATA
8401 TAAGGGTCGA ACGAAAAATA AAGTGAAAAG TGTGATATG ATGTATTGG CTTTGC GCGC
8461 CCGAAAAAAC GAGTTTACGC AATTGCACAA TCATGCTGAC TCTGTGCGG ACCCGCGCTC
8521 TTGCCGCCCC GCGGATAACG CTGGGCTGTA GGCTGTGCC GCGGAGTTT TTTGCGCCTG
8581 CATTTTCCAA GGTTTACCCT GCGCTAAGGG GCGAGATTGG AGAAGCAATA AGAATGCCGG
8641 TTGGGGTTGC GATGATGACG ACCACGACAA CTGGTGTGAT TATTTAAGTT GCCGAAAGAA
8701 CCTGAGTGCA TTTGCAACAT GAGTATACTA GAAGAATGAG CCAAGACTTG CGAGACGCGA
8761 GTTTGCCGGT GGTGCGAACA ATAGAGCGAC CATGACCTTG AAGGTGAGAC GCGCATAACC
8821 GCTAGAGTAC TTTGAAGAGG AAACAGCAAT AGGGTTGCTA CCAGTATAAA TAGACAGGTA
8881 CATACAACAC TGGAAATGGT TGTCTGTTTG AGTACGCTTT CAA

Figure 42

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pDEST23

His6 carboxy-fusion vector, T7 promoter,



|| ——— Cm^R ——— ccdB ——— ||

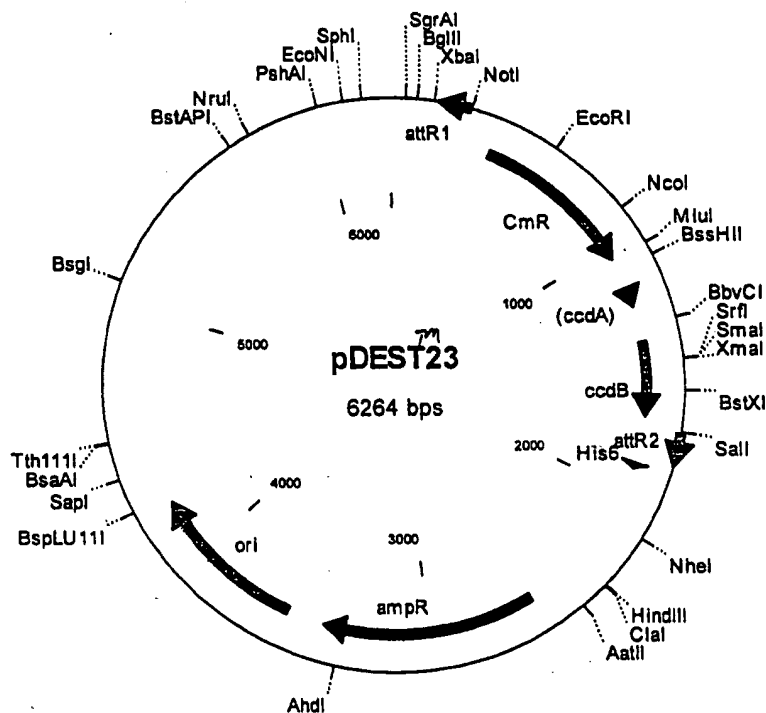


FIGURE 43A

pDEST23 6264 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
285..161		attR1
394..1053		CmR
1173..1257		inactivated ccdA
1395..1700		ccdB
1741..1865		attR2
1883..1911		his6
2574..3434		ampR
3583..4222		ori

1	TCTTCCCAT	CGGTGATGTC	GGCGATATAG	GCGCCAGCAA	CCGCACCTGT	GGCGCCGGTG
61	ATGCCGGCCA	CGATGCGTCC	GGCGTAGAGG	ATCGAGATCT	CGATCCCGCG	AAATTAATAC
121	GACTCACTAT	AGGGAGACCA	CAACGGTTTC	CCTCTAGATC	ACAAGTTTGT	ACAAAAAAGC
181	TGAACGAGAA	ACGTAAAATG	ATATAAATAT	CAATATATTA	AATTAGATTT	TGCATAAAAA
241	ACAGACTACA	TAATACTGTA	AAACACAACA	TATCCAGTCA	CTATGGCGGC	CGCATTAGGC
301	ACCCAGGCT	TTACACTTTA	TGCTTCCGGC	TCGTATAATG	TGTGGATTTT	GAGTTAGGAT
361	CCGGCGAGAT	TTTCAGGAGC	TAAGGAAGCT	AAAATGGAGA	AAAAAATCAC	TGGATATACC
421	ACCGTTGATA	TATCCCAATG	GCATCGTAAA	GAACATTTTG	AGGCATTTCA	GTCAGTTGCT
481	CAATGTACCT	ATAACCAGAC	CGTTCAGCTG	GATATTACGG	CCTTTTTTAAA	GACCGTAAAG
541	AAAAATAAGC	ACAAGTTTTA	TCCGGCCTTT	ATTACATTC	TTGCCCGCCT	GATGAATGCT
601	CATCCGGAAT	TCCGTATGGC	AATGAAAGAC	GGTGAGCTGG	TGATATGGGA	TAGTGTTCAC
661	CCTTGTTACA	CCGTTTTCCA	TGAGCAAAC	GAAACGTTTT	CATCGCTCTG	GAGTGAATAC
721	CACGACGATT	TCCGGCAGTT	TCTACACATA	TATTCGCAAG	ATGTGGCGTG	TTACGGTGAA
781	AACCTGGCCT	ATTTCCCTAA	AGGGTTTATT	GAGAATATGT	TTTTCGTCTC	AGCCAATCCC
841	TGGGTGAGTT	TCACCAAGTT	TGATTTAAAC	GTGGCCAATA	TGGACAACTT	CTTCGCCCCC
901	GTTTTACCA	TGGGCAAATA	TTATACGCAA	GGCGACAAGG	TGCTGATGCC	GCTGGCGATT
961	CAGGTTTCATC	ATGCCGTCTG	TGATGGCTTC	CATGTCGGCA	GAATGCTTAA	TGAATTACAA
1021	CAGTACTGCG	ATGAGTGCGA	GGGCGGGGCG	TAAACGCGTG	GATCCGGCTT	ACTAAAAGCC
1081	AGATAACAGT	ATGCGTATTT	GCGCGCTGAT	TTTTGCGGTA	TAAGAATATA	TACTGATATG
1141	TATACCCGAA	GTATGTCAAA	AAGAGGTGTG	CTATGAAGCA	GCGTATTACA	GTGACAGTTG
1201	ACAGCGACAG	CTATCAGTTG	CTCAAGGCAT	ATATGATGTC	AATATCTCCG	GTCTGGTAAG
1261	CACAACCATG	CAGAATGAAG	CCCGTCGTCT	GCGTGCCGAA	CGCTGGAAAG	CGGAAAATCA
1321	GGAAGGGATG	GCTGAGGTCT	CCCGGTTTAT	TGAAATGAAC	GGCTCTTTTG	CTGACGAGAA
1381	CAGGGACTGG	TGAAATGCAG	TTTAAGGTTT	ACACCTATAA	AAGAGAGAGC	CGTTATCGTC
1441	TGTTTGTTGA	TGTACAGAGT	GATATTATTG	ACACGCCCCG	GCGACGGATG	GTGATCCCCC
1501	TGGCCAGTGC	ACGTCTGCTG	TCAGATAAAG	TCTCCCGTGA	ACTTTACCCG	GTGGTGCTTA
1561	TCGGGGATGA	AAGCTGGCGC	ATGATGACCA	CCGATATGGC	CAGTGTGCCG	GTCTCCGTTA
1621	TCGGGGAAGA	AGTGGCTGAT	CTCAGCCACC	GCGAAAATGA	CATCAAAAAC	GCCATTAAAC
1681	TGATGTTCTG	GGGAATATAA	ATGTCAGGCT	CCCTTATACA	CAGCCAGTCT	GCAGGTCGAC
1741	CATAGTGAAT	GGATATGTTG	TGTTTACAG	TATTATGTAG	TCTGTTTTTT	ATGCAAAATC
1801	TAATTTAATA	TATTGATATT	TATATCATTT	TACGTTTCTC	GTTTCAGCTT	CTTGTAACAA
1861	GTGGTGATTA	TGTCGTACTA	CCATCACCAT	CACCATCACC	TCGATGAGCA	ATAACTAGCA
1921	TAACCCCTTG	GGGCCTCTAA	ACGGGTCTTG	AGGGGTTTTT	TGCTGAAAGG	AGGAACTATA
1981	TCCGGATATC	CACAGGACGG	GTGTGGTTCG	CATGATCGCG	TAGTCGATAG	TGGCTCCAAG
2041	TAGCGAAGCG	AGCAGGACTG	GGCGGCGGCC	AAAGCGGTCT	GACAGTGCTC	CGAGAACGGG
2101	TGCGCATAGA	AATTGCATCA	ACGCATATAG	CGTAGCAGC	ACGCCATAGT	GACTGGCGAT
2161	GCTGTGCGAA	TGGACGATAT	CCCGCAAGAG	GCCCGGCAGT	ACCGGCATAA	CCAAGCCTAT
2221	GCCTACAGCA	TCCAGGGTGA	CGGTGCCGAG	GATGACGATG	AGCGCATTGT	TAGATTTTCAT
2281	ACACGGTGCC	TGACTGCGTT	AGCAATTTAA	CTGTGATAAA	CTACCGCATT	AAAGCTTATC
2341	GATGATAAGC	TGTCAAACAT	GAGAATTCTT	GAAGACGAAA	GGGCCTCGTG	ATACGCCTAT
2401	TTTATAGGT	TAATGTCATG	ATAATAATGG	TTTCTTAGAC	GTCAGGTGGC	ACTTTTCGGG
2461	GAAATGTGCG	CGGAACCCCT	ATTGTTTAT	TTTTCTAAAT	ACATTCAAAT	ATGTATCCGC
2521	TCATGAGACA	ATAACCCCTGA	TAAATGCTTC	AATAATATTG	AAAAAGGAAG	AGTATGAGTA
2581	TTCAACATTT	CCGTGTCGCC	CTTATCCCT	TTTTTGCGGC	ATTTTGCCCT	CCTGTTTTTG
2641	CTCACCCAGA	AACGCTGGTG	AAAGTAAAG	ATGCTGAAGA	TCAGTTGGGT	GCACGAGTGG

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2701 GTTACATCGA ACTGGATCTC AACAGCGGTA AGATCCTTGA GAGTTTTTCGC CCCGAAGAAC
2761 GTTTTCCAAT GATGAGCACT TTTAAAGTTC TGCTATGTGG CGCGGTATTA TCCCGTGTGG
2821 ACGCCGGGCA AGAGCAACTC GGTCCGCCGA TACACTATTC TCAGAATGAC TTGGTTGAGT
2881 ACTCACCAGT CACAGAAAAG CATCTTACGG ATGGCATGAC AGTAAGAGAA TTATGCAGTG
2941 CTGCCATAAC CATGAGTGAT AACACTGCGG CCAACTTACT TCTGACAACG ATCGGAGGAC
3001 CGAAGGAGCT AACCGCTTTT TTGCACAACA TGGGGGATCA TGTAACTCGC CTTGATCGTT
3061 GGGAAACCGGA GCTGAATGAA GCCATACCAA ACGACGAGCG TGACACCACG ATGCCTGCAG
3121 CAATGGCAAC AACGTTGCGC AAACCTATTAA CTGGCGAACT ACTTACTCTA GCTTCCCGGC
3181 AACAAATTAAT AGACTGGATG GAGGCGGATA AAGTTGCAGG ACCACTTCTG CGCTCGGCCC
3241 TTCCGGCTGG CTGGTTTATT GCTGATAAAT CTGGAGCCGG TGAGCGTGGG TCTCGCGGTA
3301 TCATTGACAGC ACTGGGGCCA GATGGTAAGC CCTCCCGTAT CGTAGTTATC TACACGACGG
3361 GGAGTCAGGC AACTATGGAT GAACGAAATA GACAGATCGC TGAGATAGGT GCCTCACTGA
3421 TTAAGCATTG GTAACGTGCA GACCAAGTTT ACTCATATAT ACTTTAGATT GATTTAAAAC
3481 TTCATTTTAA ATTTAAAAGG ATCTAGGTGA AGATCCTTTT TGATAATCTC ATGACCAAAA
3541 TCCCTTAACG TGAGTTTTCG TTCCACTGAG CGTCAGACCC CGTAGAAAAG ATCAAAGGAT
3601 CTTCTTGAGA TCCTTTTTCG CTGCGCGTAA TCTGCTGCTT GCAAACAAAA AAACCAACCGC
3661 TACCAGCGGT GGTGTTGTTG CCGGATCAAG AGCTACCAAC TCTTTTTCGG AAGGTAACGT
3721 GCTTCAGCAG AGCGCAGATA CCAAATACTG TCCTTCTAGT GTAGCCGTAG TTAGGCCACC
3781 ACTTCAAGAA CTCTGTAGCA CCGCCTACAT ACCTCGCTCT GCTAATCCTG TTACCAGTGG
3841 CTGCTGCCAG TGGCGATAAG TCGTGTCTTA CCGGGTTGGA CTCAAGACGA TAGTTACCGG
3901 ATAAGGCGCA GCGGTCGGGC TGAACGGGGG GTTCGTGCAC ACAGCCCGAGC TTGGAGCGAA
3961 CGACCTACAC CGAACTGAGA TACCTACAGC GTGAGCTATG AGAAAGCGCC ACGCTTCCCG
4021 AAGGGAGAAA GCGCGACAGG TATCCGGTAA GCGGCAGGGT CGGAACAGGA GAGCGCACGA
4081 GGGAGCTTCC AGGGGGAAAC GCCTGGTATC TTTATAGTCC TGTCGGGTTT CGCCACCTCT
4141 GACTTGAGCG TCGATTTTGG TGATGCTCGT CAGGGGGGCG GAGCCTATGG AAAAACGCCA
4201 GCAACGCGGC CTTTTTACGG TTTCTGGCCT TTTGCTGGCC TTTTGCTCAC ATGTTCTTTC
4261 CTGCGTTATC CCCTGATTCT GTGGATAACC GTATTACCGC CTTTGAGTGA GCTGATACCG
4321 CTCGCCGAG CCGAACGACC GAGCGCAGCG AGTCAGTGAG CGAGGAAGCG GAAGAGCGCC
4381 TGATGCGGTA TTTTCTCCTT ACGCATCTGT GCGGTATTTC ACACCGCATA TATGGTGCAC
4441 TCTCAGTACA ATCTGCTCTG ATGCCGCATA GTTAAGCCAG TATACACTCC GCTATCGCTA
4501 CGTGAAGTGG TCATGGCTGC GCCCCGACAC CCGCCAACAC CCGCTGACGC GCCCTGACGG
4561 GCTTGTCTGC TCCCGGCATC CGCTTACAGA CAAGCTGTGA CCGTCTCCGG GAGCTGCATG
4621 TGTCAGAGGT TTTACCCGTC ATCACCAGAA CGCGCGAGGC AGCTGCGGTA AAGCTCATCA
4681 GCGTGGTCGT GAAGCGATTG ACAGATGTCT GCCTGTTTAT CCGCGTCCAG CTCGTTGAGT
4741 TTCTCCAGAA GCGTTAATGT CTGGCTTCTG ATAAAGCGGG CCATGTTAAG GCGGTTTTT
4801 TCCTGTTTGG TCACTGATGC CTCGCTGATA GGGGGATTTC TGTTTATGGG GGTAAATGATA
4861 CCGATGAAAC GAGAGAGGAT GCTCAGATA CCGGTTACTG ATGATGAACA TGCCCCGTTA
4921 CTGGAACGTT GTGAGGGTAA ACAACTGGCG GTATGGATGC GGCGGGACCA GAGAAAAATC
4981 ACTCAGGGTC AATGCCAGCG CTTTCGTTAAT ACAGATGTAG GTGTTCCACA GGGTATGCCAG
5041 CAGCATCCTG CGATGCAGAT CCGGAACATA ATGGTGCAGG GCGCTGACTT CCGCGTTTTCC
5101 AGACTTTACG AAACACGGAA ACCGAAGACC ATTATGTTG TTGCTCAGGT CGCAGACGTT
5161 TTGCAGCAGC AGTCGCTTCA CGTTCGCTCG CGTATCGGTG ATTCAATCTG CTAACCAGTA
5221 AGGCAACCCC GCCAGCCTAG CCGGGTCCTC AACGACAGGA GCACGATCAT GCGCACCCGT
5281 GGCCAGGACC CAACGCTGCC CGAGATGCGC CGCGTGCGGC TGCTGGAGAT GCGCGACCGG
5341 ATGGATATGT TCTGCCAAGG GTTGGTTTGC GCATTACAGG TTCTCCGCAA GAATTGATTG
5401 GCTCCAATTC TTGGAGTGGT GAATCCGTTA GCGAGGTGCC GCCGGCTTCC ATTACAGTCC
5461 AGGTGGCCCCG GCTCCATGCA CCGCGACGGA ACGCGGGGAG GCAGACAAGG TATAGGGCGG
5521 CGCCTACAAT CCATGCCAAC CCGTTCCATG TGCTCGCCGA GGCGGCATAA ATCGCCGTGA
5581 CGATCAGCGG TCCAGTGATC GAAGTTAGGC TGTAAGAGC CGCGAGCGAT CCTTGAAGCT
5641 GTCCCTGATG GTCGTCATCT ACCTGCCTGG ACAGCATGGC CTGCAACGCG GGCATCCCCA
5701 TGCCGCCGGA AGCGAGAAGA ATCATAATGG GGAAGGCCAT CCAGCCTCGC GTCGCGAACG
5761 CCAGCAAGAC GTAGCCCAGC GCGTCGGCCG CCATGCCGGC GATAATGGCC TGCTTCTCGC
5821 CGAAACGTTT GGTGGCGGGA CCAGTGACGA AGGCTTGAGC GAGGGCGTGC AAGATTCCGA
5881 ATACCGCAAG CGACAGGCCG ATCATCGTCG CGCTCCAGCG AAAGCGGTCC TCGCCGAAAA
5941 TGACCCAGAG CGCTGCCGGC ACCTGTCCTA CGAGTTGCAT GATAAAGAAG ACAGTCATAA
6001 GTGCGGCGAC GATAGTCATG CCCCGCGCCC ACCGGAAGGA GCTGACTGGG TTGAAGGCTC
6061 TCAAGGGCAT CGGTCGATCG ACGCTCTCCC TTATGCGACT CCTGCATTAG GAAGCAGCCC
6121 AGTAGTAGGT TGAGGCCGTT GAGCACCGCC GCCGCAAGGA ATGGTGCATG CAAGGAGATG-

FIGURE 43C

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6181 GCGCCCAACA GTCCCCGGC CACGGGGCCT GCCACCATAC CCACGCCGAA ACAAGCGCTC
6241 ATGAGCCCGA AGTGGCGAGC CCGA

FIGURE 43D

PDEST24

1 atc gag atc tgc atc ccg cga aat taa tac gac tca cta tag gga gac cac → mRNA
 tag ctc tag agc tag ggc gct tta att atg ctg agt gat atc cgt ctg gtg

52 aac ggt ttc oot cta gat cac aag ttt gta caa aaa agc tga acg aga aac att R1 att R2 att R3 att R4 att R5 att R6 att R7 att R8 att R9 att R10 att R11 att R12 att R13 att R14 att R15 att R16 att R17 att R18 att R19 att R20 att R21 att R22 att R23 att R24 att R25 att R26 att R27 att R28 att R29 att R30 att R31 att R32 att R33 att R34 att R35 att R36 att R37 att R38 att R39 att R40 att R41 att R42 att R43 att R44 att R45 att R46 att R47 att R48 att R49 att R50 att R51 att R52 att R53 att R54 att R55 att R56 att R57 att R58 att R59 att R60 att R61 att R62 att R63 att R64 att R65 att R66 att R67 att R68 att R69 att R70 att R71 att R72 att R73 att R74 att R75 att R76 att R77 att R78 att R79 att R80 att R81 att R82 att R83 att R84 att R85 att R86 att R87 att R88 att R89 att R90 att R91 att R92 att R93 att R94 att R95 att R96 att R97 att R98 att R99 att R100 att R101 att R102 att R103 att R104 att R105 att R106 att R107 att R108 att R109 att R110 att R111 att R112 att R113 att R114 att R115 att R116 att R117 att R118 att R119 att R120 att R121 att R122 att R123 att R124 att R125 att R126 att R127 att R128 att R129 att R130 att R131 att R132 att R133 att R134 att R135 att R136 att R137 att R138 att R139 att R140 att R141 att R142 att R143 att R144 att R145 att R146 att R147 att R148 att R149 att R150 att R151 att R152 att R153 att R154 att R155 att R156 att R157 att R158 att R159 att R160 att R161 att R162 att R163 att R164 att R165 att R166 att R167 att R168 att R169 att R170 att R171 att R172 att R173 att R174 att R175 att R176 att R177 att R178 att R179 att R180 att R181 att R182 att R183 att R184 att R185 att R186 att R187 att R188 att R189 att R190 att R191 att R192 att R193 att R194 att R195 att R196 att R197 att R198 att R199 att R200 att R201 att R202 att R203 att R204 att R205 att R206 att R207 att R208 att R209 att R210 att R211 att R212 att R213 att R214 att R215 att R216 att R217 att R218 att R219 att R220 att R221 att R222 att R223 att R224 att R225 att R226 att R227 att R228 att R229 att R230 att R231 att R232 att R233 att R234 att R235 att R236 att R237 att R238 att R239 att R240 att R241 att R242 att R243 att R244 att R245 att R246 att R247 att R248 att R249 att R250 att R251 att R252 att R253 att R254 att R255 att R256 att R257 att R258 att R259 att R260 att R261 att R262 att R263 att R264 att R265 att R266 att R267 att R268 att R269 att R270 att R271 att R272 att R273 att R274 att R275 att R276 att R277 att R278 att R279 att R280 att R281 att R282 att R283 att R284 att R285 att R286 att R287 att R288 att R289 att R290 att R291 att R292 att R293 att R294 att R295 att R296 att R297 att R298 att R299 att R300 att R301 att R302 att R303 att R304 att R305 att R306 att R307 att R308 att R309 att R310 att R311 att R312 att R313 att R314 att R315 att R316 att R317 att R318 att R319 att R320 att R321 att R322 att R323 att R324 att R325 att R326 att R327 att R328 att R329 att R330 att R331 att R332 att R333 att R334 att R335 att R336 att R337 att R338 att R339 att R340 att R341 att R342 att R343 att R344 att R345 att R346 att R347 att R348 att R349 att R350 att R351 att R352 att R353 att R354 att R355 att R356 att R357 att R358 att R359 att R360 att R361 att R362 att R363 att R364 att R365 att R366 att R367 att R368 att R369 att R370 att R37

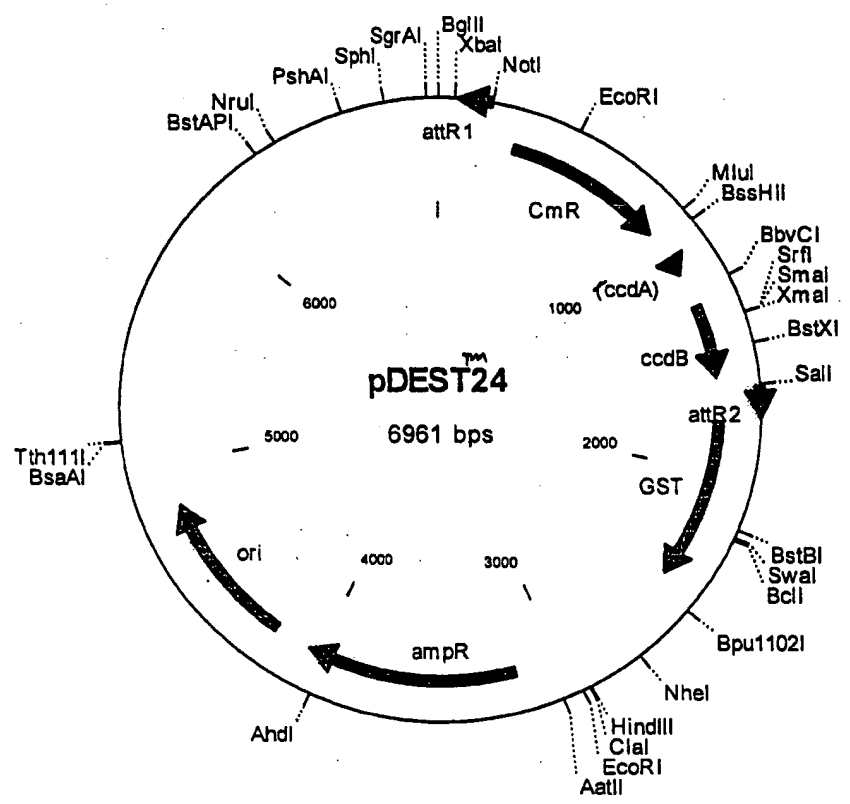


FIGURE 44A

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pDEST24 6961 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
195..71		attR1
304..963		CmR
1083..1167		inactivated ccdA
1305..1610		ccdB
1651..1775		attR2
1783..2451		GST
3181..4041		ampR
4190..4829		ori
1	ATCGAGATCT CGATCCCGCG AAATTAATAC GACTCACTAT AGGGAGACCA CAACGGTTTC	
61	CCTCTAGATC ACAAGTTTGT ACAAAAAAGC TGAACGAGAA ACGTAAAATG ATATAAATAT	
121	CAATATATTA AATTAGATTT TGCATAAAAA ACAGACTACA TAATACTGTA AAACACAACA	
181	TATCCAGTCA CTATGGCGGC CGCATTAGGC ACCCCAGGCT TTACACTTTA TGCTTCCGGC	
241	TCGTATAATG TGTGGATTTT GAGTTAGGAT CCGGCGAGAT TTTCAGGAGC TAAGGAAGCT	
301	AAAATGGAGA AAAAAATCAC TGGATATACC ACCGTTGATA TATCCCAATG GCATCGTAAA	
361	GAACATTTTG AGGCATTTCA GTCAGTTGCT CAATGTACCT ATAACCAGAC CGTTCAGCTG	
421	GATATTACGG CCTTTTAAA GACCGTAAAG AAAAATAAGC ACAAGTTTTA TCCGGCCTTT	
481	ATTCACATTC TTGCCCCGCT GATGAATGCT CATCCGGAAT TCCGTATGGC AATGAAAGAC	
541	GGTGAGCTGG TGATATGGGA TAGTGTTCAC CCTTGTTACA CCGTTTTCCA TGAGCAAAC	
601	GAAACGTTTT CATCGCTCTG GAGTGAATAC CACGACGATT TCCGGCAGTT TCTACACATA	
661	TATTCGCAAG ATGTGGCGTG TTACGGTGAA AACCTGGCCT ATTTCCCTAA AGGGTTTATT	
721	GAGAATATGT TTTTCGTCTC AGCCAATCCC TGGGTGAGTT TCACCAAGTT TGATTTAAAC	
781	GTGGCCAATA TGGACAACTT CTTGCCCCC GTTTTCACCA TGGGCAAATA TTATACGCAA	
841	GGCGACAAGG TGCTGATGCC GCTGGCGATT CAGGTTTCATC ATGCCGCTG TGATGGCTTC	
901	CATGTCGGCA GAATGCTTAA TGAATTACAA CAGTACTGCG ATGAGTGGCA GGGCGGGGCG	
961	TAAACGCGTG GATCCGGCTT ACTAAAAGCC AGATAACAGT ATGCCGTATTT GCGCGCTGAT	
1021	TTTTGCGGTA TAAGAATATA TACTGATATG TATACCCGAA GTATGTCAAA AAGAGGTGTG	
1081	CTATGAAGCA GCGTATTACA GTGACAGTTG ACAGCGACAG CTATCAGTTG CTCAAGGCAT	
1141	ATATGATGTC AATATCTCCG GTCTGGTAAG CACAACCATG CAGAATGAAG CCCGTCGTCT	
1201	GCGTGCCGAA CGCTGGAAAG CGGAAAATCA GGAAGGGATG GCTGAGGTG CCCGGTTTAT	
1261	TGAAATGAAC GGCTCTTTTG CTGACGAGAA CAGGGACTGG TGAAATGCAG TTTAAGGTTT	
1321	ACACCTATAA AAGAGAGAGC CGTTATCGTC TGTGTGTGGA TGTACAGAGT GATATTATG	
1381	ACACGCCCCG GCGACGGATG GTGATCCCCC TGGCCAGTGC ACGTCTGCTG TCAGATAAAG	
1441	TCTCCCGTGA ACTTTACCCG GTGGTGCATA TCGGGGATGA AAGCTGGCGC ATGATGACCA	
1501	CCGATATGGC CAGTGTGCCG GTCTCCGTTA TCGGGGAAGA AGTGGCTGAT CTCAGCCACC	
1561	GCGAAAATGA CATCAAAAAC GCCATTAACC TGATGTTCTG GGAATATAA ATGTCAGGCT	
1621	CCCTTATACA CAGCCAGTCT GCAGGTCGAC CATAGTGAAT GGATATGTTG TGTTTTACAG	
1681	TATTATGTAG TCTGTTTTTT ATGCAAAATC TAATTTAATA TATTGATATT TATATCATTT	
1741	TACGTTTCTC GTTCAGCTTT CTGTACAAA GTGGTGATTA TGTCCCTAT ACTAGGTTAT	
1801	TGGAAAATTA AGGGCCTTGT GCAACCCACT CGACTTCTTT TGGAATATCT TGAAGAAAAA	
1861	TATGAAGAGC ATTTGTATGA GCGCGATGAA GGTGATAAAT GGCGAAACAA AAAGTTTGAA	
1921	TTGGGTTTGG AGTTTCCCAA TCTTCCTTAT TATATTGATG GTGATGTTAA ATTAACACAG	
1981	TCTATGGCCA TCATACGTTA TATAGCTGAC AAGCACAACA TGTTGGGTGG TTGTCCAAAA	
2041	GAGCGTGCAG AGATTTC AAT GCTTGAAGGA GCGGTTTGG ATATTAGATA CGGTGTTTCG	
2101	AGAATTGCAT ATAGTAAAGA CTTTGAAGCT CTCAAAGTTG ATTTTCTTAG CAAGCTACCT	
2161	GAAATGCTGA AAATGTTCTG AGATCGTTTA TGTCAATAAA CATATTTAAA TGGTGATCAT	
2221	GTAACCCATC CTGACTTCAT GTTGTATGAC GCTCTTGATG TTGTTTTATA CATGGACCCA	
2281	ATGTGCCTGG ATGCGTTCCC AAAATTAGTT TGTTTTAAAA AACGTATTGA AGCTATCCCA	
2341	CAAAATTGATA AGTACTTGAA ATCCAGCAAG TATATAGCAT GGCCTTTGCA GGGCTGGCAA	
2401	GCCACGTTTG GTGGTGCGCA CCATCCTCCA AAATCGGATC TGGTCCGCG TCCATGGGGA	
2461	TCCGGCTGCT AACAAAGCCC GAAAGGAAGC TGAGTTGGCT GCTGCCACCG CTGAGCAATA	
2521	ACTAGCATAA CCCCTTGGGG CCTCTAAACG GGTCTTGAGG GGTTTTTTCG TGAAAGGAGG	
2581	AACTATATCC GGATATCCAC AGGACGGGTG TGGTCGCCAT GATCGCGTAG TCGATAGTGG	
2641	CTCCAAGTAG CGAAGCGAGC AGGACTGGGC GGCGGCCAAA GCGGTCGGAC AGTGCTCCGA-	

FIGURE 44B

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2701 GAACGGGTGC GCATAGAAAT TGCATCAACG CATATAGCGC TAGCAGCACG CCATAGTGAC
2761 TGGCGATGCT GTCGGAATGG ACGATATCCC GCAAGAGGCC CGGCAGTACC GGCATAACCA
2821 AGCCTATGCC TACAGCATCC AGGGTGACGG TGCCGAGGAT GACGATGAGC GCATTGTTAG
2881 ATTTTCATACA CGGTGCCTGA CTGCGTTAGC AATTTAACTG TGATAAACTA CCGCATTAAA
2941 GCTTATCGAT GATAAGCTGT CAAACATGAG AATTCTTGAA GACGAAAGGG CCTCGTGATA
3001 CGCCTATTTT TATAGGTAA TGTCATGATA ATAATGGTTT CTTAGACGTC AGGTGGCACT
3061 TTTCCGGGAA ATGTGCGCGG AACCCCTATT TGTTTATTTT TCTAAATACA TTCAAATATG
3121 TATCCGCTCA TGAGACAATA ACCCTGATAA ATGCTTCAAT AATATTGAAA AAGGAAGAGT
3181 ATGAGTATTC AACATTTCCG TGTCGCCCTT ATTCCCTTTT TTGCGGCATT TTGCCTTCCT
3241 GTTTTTGCTC ACCCAGAAAC GCTGGTGAAA GTAAAAGATG CTGAAGATCA GTTGGGTGCA
3301 CGAGTGGGTT ACATCGAACT GGATCTCAAC AGCGGTAAGA TCCTTGAGAG TTTTCGCCCC
3361 GAAGAACGTT TTCCAATGAT GAGCACTTTT AAAGTTCCTG TATGTGGCGC GGTATTATCC
3421 CGTGTGACG CCGGGCAAGA GCAACTCGGT CGCCGCATAC ACTATTCTCA GAATGACTTG
3481 GTTGAGTACT CACCAGTCAC AGAAAAGCAT CTTACGGATG GCATGACAGT AAGAGAATTA
3541 TGCAGTCTG CCATAACCAT GAGTGATAAC ACTGCGGCCA ACTTACTTCT GACAACGATC
3601 GGAGGACCGA AGGAGCTAAC CGCTTTTGTG CACAACATGG GGGATCATGT AACTGCCTT
3661 GATCGTTGGG AACCGGAGCT GAATGAAGCC ATACCAAACG ACGAGCGTGA CACCACGATG
3721 CCTGCAGCAA TGGCAACAAC GTTGCAGCAA CTATTAAGTG GCGAACTACT TACTCTAGCT
3781 TCCCGGCAAC AATTAATAGA CTGGATGGAG GCGGATAAAG TTGCAGGACC ACTTCTGCGC
3841 TCGGCCCTTC CGGCTGGCTG GTTTATTGCT GATAAATCTG GAGCCGGTGA GCGTGGGTCT
3901 CGCGGTATCA TTGCAGCACT GGGGCCAGAT GGTAAGCCCT CCCGTATCGT AGTTATCTAC
3961 ACGACGGGGA GTCAGGCAAC TATGGATGAA CGAAATAGAC AGATCGCTGA GATAGGTGCC
4021 TCACTGATTA AGCATTTGGT ACTGTCAGAC CAAGTTTACT CATATATACT TTAGATTGAT
4081 TTAATACTTC ATTTTAAATT TAAAAGGATC TAGGTGAAGA TCCTTTTGA TAATCTCATG
4141 ACCAAAATCC CTTAACGTGA GTTTTCGTTT CACTGAGCGT CAGACCCCGT AGAAAAGATC
4201 AAAGGATCTT CTTGAGATCC TTTTTCGTTG CGCGTAATCT GCTGCTTGCA AACAAAAAAA
4261 CCACCGCTAC CAGCGGTGGT TTGTTTGCCG GATCAAGAGC TACCAACTCT TTTTCCGAAG
4321 GTAACGGCT TCAGCAGAGC GCAGATACCA AATACTGTCC TTCTAGTGTA GCCGTAGTTA
4381 GGCCACCACT TCAAGAACTC TGAGCAGCCG CCTACATACC TCGCTCTGCT AATCCTGTTA
4441 CCAGTGGCTG CTGCCAGTGG CGATAAGTCG TGTCTTACCG GGTGGACTC AAGACGATAG
4501 TTACCGGATA AGGCGCAGCG GTCGGGCTGA ACGGGGGGTT CGTGACACA GCCCAGCTTG
4561 GAGCGAACGA CCTACACCGA ACTGAGATAC CTACAGCGTG AGCTATGAGA AAGCGCCACG
4621 CTTCCTGAAG GGAGAAAGGC GGACAGGTAT CCGGTAAGCG GCAGGGTCCG AACAGGAGAG
4681 CGCAGGAGGG AGCTTCCAGG GGGAAACGCC TGGTATCTTT ATAGTCCTGT CGGGTTTCGC
4741 CACCTCTGAC TTGAGCGTCG ATTTTGTGTA TGCTCGTCAG GGGGGCGGAG CCTATGGAAA
4801 AACGCCAGCA ACGCGGCTTT TTTACGTTTC CTGGCCTTTT GCTGGCCTTT TGCTCACATG
4861 TTCTTTCCTG CGTTATCCCC TGATTCTGTG GATAACCGTA TTACCGCCTT TGAGTGAAGT
4921 GATACCGCTC GCCGCAGCCG AACGACCGAG CGCAGCGAGT CAGTGAGCGA GGAAGCGGAA
4981 GAGCGCCTGA TGCGGTATTT TCTCCTTACG CATCTGTGCG GTATTTTACA CCGCATATAT
5041 GGTGCACTCT CAGTACAATC TGCTCTGATG CCGCATAGTT AAGCCAGTAT ACACTCCGCT
5101 ATCGCTACGT GACTGGGTCA TGGCTGCGCC CCGACACCCG CCAACACCCG CTGACGCGCC
5161 CTGACGGGCT TGTCTGCTCC CGGCATCCGC TTACAGACAA GCTGTGACCG TCTCCGGGAG
5221 CTGCATGTGT CAGAGGTTTT CACCGTCATC ACCGAAACGC GCGAGGCAGC TGCGGTAAAG
5281 CTCATCAGCG TGGTCGTGAA GCGATTACCA GATGTCTGCC TGTTTCATCCG CGTCCAGCTC
5341 GTTGAGTTTC TCCAGAAGCG TTAATGTCTG GCTTCTGATA AAGCGGGCCA TGTTAAGGGC
5401 GGTTTTTTCC TGTTTGGTCA CTGATGCCTC CGTGTAAAGG GGATTTCTGT TCATGGGGGT
5461 AATGATACCG ATGAAAACGAG AGAGGATGCT CACGATACGG GTTACTGATG ATGAAGTATG
5521 CCGGTTACTG GAACGTTGTG AGGGTAAACA ACTGGCGGTA TGGATGCGGC GGGACCAGAG
5581 AAAAATCACT CAGGGTCAAT GCCAGCGCTT CGTTAATACA GATGTAGGTG TTCCACAGGG
5641 TAGCCAGCAG CATCCTGCGA TGCAGATCCG GAACATAATG GTGCAGGGCG CTGACTTCCG
5701 CGTTTCCAGA CTTTACGAAA CACGGAACCC GAAGACCATT CATGTTGTTG CTCAGGTGCG
5761 AGACGTTTTG CAGCAGCAGT CGCTTACAGT TCGCTCGCGT ATCGGTGATT CATTCTGCTA
5821 ACCAGTAAGG CAACCCCGCC AGCCTAGCCG GGTCTCTAAC GACAGGAGCA CGATCATGCG
5881 CACCCGTGGC CAGGACCCAA CGCTGCCCGA GATGCGCCGC GTGCGGCTGC TGGAGATGGC
5941 GGACGCGATG GATATGTTCT GCCAAGGGTT GGTTTGCGCA TTCACAGTTC TCCGCAAGAA
6001 TTGATTGGCT CCAATTCTTG GAGTGGTGAA TCCGTTAGCG AGGTGCCCGC GGCTTCCATT
6061 CAGGTGAGG TGGCCCGGCT CCATGCACCG CGAGCGAACG CGGGGAGGCA GACAAGGTAT
6121 AGGGCGGCGC CTACAATCCA TGCCAACCCG TTCCATGTGC TCGCCGAGGC GGCATAAATC

FIGURE 44C

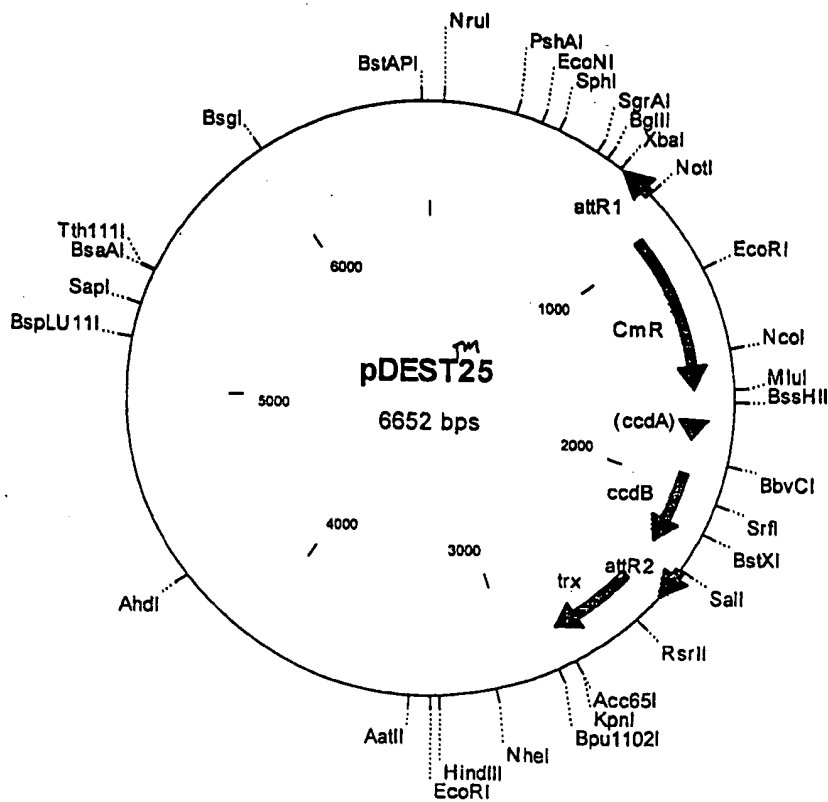
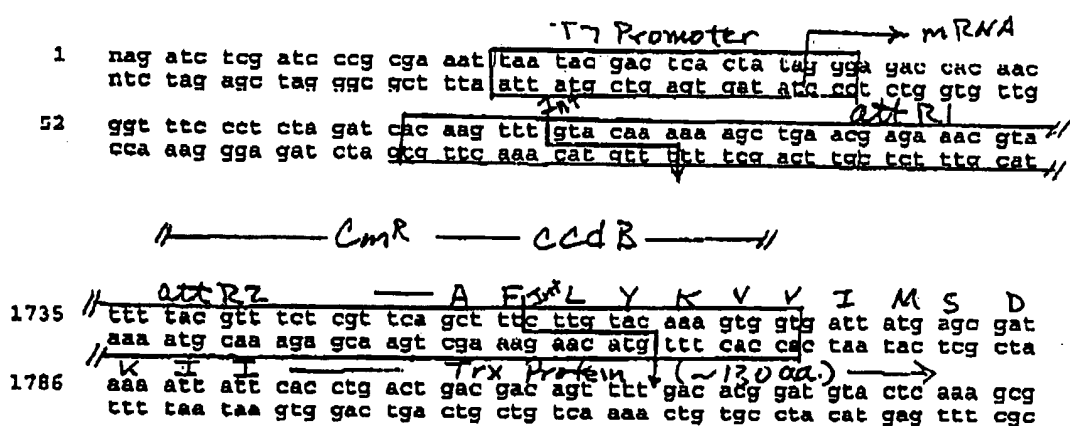
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6181 GCCGTGACGA TCAGCGGTCC AGTGATCGAA GTTAGGCTGG TAAGAGCCGC GAGCGATCCT
6241 TGAAGCTGTC CCTGATGGTC GTCATCTACC TGCCTGGACA GCATGGCCTG CAACGCGGGC
6301 ATCCCGATGC CGCCGGAAGC GAGAAGAATC ATAATGGGGA AGGCCATCCA GCCTCGCGTC
6361 GCGAACGCCA GCAAGACGTA GCCCAGCGCG TCGGCCGCCA TGCCGGCGAT AATGGCCTGC
6421 TTCTCGCCGA AACGTTTGGT GGCGGGACCA GTGACGAAGG CTTGAGCGAG GCGGTGCAAG
6481 ATTCCGAATA CCGCAAGCGA CAGGCCGATC ATCGTCGCGC TCCAGCGAAA GCGGTCCCTCG
6541 CCGAAAATGA CCCAGAGCGC TGCCGGCACC TGTCTACGA GTTGCGATGAT AAAGAAGACA
6601 GTCATAAGTG CGGCGACGAT AGTCATGCCC CGCGCCCACC GGAAGGAGCT GACTGGGTTG
6661 AAGGCTCTCA AGGGCATCGG TCGATCGACG CTCTCCCTTA TGCGACTCCT GCATTAGGAA
6721 GCAGCCCAGT AGTAGGTTGA GGCCGTTGAG CACCGCCGCC GCAAGGAATG GTGCGATCAA
6781 GGAGATGGCG CCCAACAGTC CCCCAGGCCAC GGGGCCTGCC ACCATACCCA CGCCGAAACA
6841 AGCGCTCATG AGCCCGAAGT GGCAGAGCCG ATCTTCCCA TCGGTGATGT CGGCGATATA
6901 GGCGCCAGCA ACCGCACCTG TGGCGCCGGT GATGCCGGCC ACGATGCGTC CGGCGTAGAG
6961 G

FIGURE 44D

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FIGURE 45A

Thioredoxin carboxy-fusion vector, T7 promoter



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pDEST25 6652 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
844..720		attR1
953..1612		CmR
1732..1816		inactivated ccdA
1954..2259		ccdB
2300..2424		attR2
2432..2794		trx
1	CCGGAAGCGA GAAGAATCAT AATGGGGAAG GCCATCCAGC CTCGCGTCGC GAACGCCAGC	
61	AAGACGTAGC CCAGCGCGTC GGCCGCCATG CCGGCGATAA TGGCCTGCTT CTCGCCGAAA	
121	CGTTTGGTGG CGGGACCACT GACGAAGGCT TGAGCGAGGG CGTGCAAGAT TCCGAATACC	
181	GCAAGCGACA GGCCGATCAT CGTCGCGCTC CAGCGAAAGC GGTCCTCGCC GAAAATGACC	
241	CAGAGCGCTG CCGGCACCTG TCCTACGAGT TGCATGATAA AGAAGACAGT CATAAGTGCG	
301	GCGACGATAG TCATGCCCCG CGCCACCAGG AAGGAGCTGA CTGGGTTGAA GGCTCTCAAG	
361	GGCATCGGTC GATCGACGCT CTCCTTATG CACTCTCTGC ATTAGGAAGC AGCCCAGTAG	
421	TAGGTTGAGG CCGTTGAGCA CCGCCGCCGC AAGGAATGGT GCATGCAAGG AGATGGCGCC	
481	CAACAGTCCC CCGGCCACGG GGCCTGCCAC CATACCCACG CCGAAACAAG CGCTCATGAG	
541	CCCGAAGTGG CGAGCCCGAT CTTCCCCATC GGTGATGTCG GCGATATAGG CGCCAGCAAC	
601	CGCACCTGTG GCGCCGGTGA TGCCGCCAC GATGCGTCCG GCGTAGAGGA TCGAGATCTC	
661	GATCCCGCGA AATTAATACG ACTCACTATA GGGAGACCAC AACGGTTTCC CTCTAGATCA	
721	CAAGTTTGTA CAAAAAGCT GAACGAGAAA CGTAAATGA TATAAATATC AATATATTAA	
781	ATTAGATTTT GCATAAAAA CAGACTACAT AATACTGTAA AACACAACAT ATCCAGTCAC	
841	TATGGCGGCC GCATTAGGCA CCCCAGGCTT TACACTTTAT GCTTCCGGCT CGTATAATGT	
901	GTGGATTTTG AGTTAGGATC CGGCGAGATT TTCAGGAGCT AAGGAAGCTA AAATGGAGAA	
961	AAAAATCACT GGATATACCA CCGTTGATAT ATCCCAATGG CATCGTAAAG AACATTTTGA	
1021	GGCATTTCAG TCAGTTGCTC AATGTACCTA TAACCAGACC GTTCAGCTGG ATATTACGGC	
1081	CTTTTAAAG ACCGTAAAGA AAAATAAGCA CAAGTTTAT CCGGCCTTTA TTCACATTCT	
1141	TGCCCGCCTG ATGAATGCTC ATCCGGAATT CCGTATGGCA ATGAAAGACG GTGAGCTGGT	
1201	GATATCGGAT AGTGTTCACC CTTGTTACAC CGTTTTCCAT GAGCAAACCTG AAACGTTTTTC	
1261	ATCGCTCTGG AGTGAATACC ACGACGATTT CCGGCAGTTT CTACACATAT ATTGCAAGA	
1321	TGTGGCGTGT TACGGTGAAA ACCTGGCCTA TTTCCCTAAA GGGTTTATTG AGAATATGTT	
1381	TTTCGTCTCA GCCAATCCCT GGGTGAGTTT CACCAAGTTT GATTTAAACG TGGCCAATAT	
1441	GGACAACTTC TTCGCCCCCG TTTTCACCAT GGGCAAATAT TATACGCAAG GCGACAAGGT	
1501	GCTGATGCCG CTGGCGATTC AGGTTTCATCA TGCCGTCTGT GATGGCTTCC ATGTCGGCAG	
1561	AATGCTTAAT GAATTACAAC AGTACTGCGA TGAGTGGCAG GGCGGGGCGT AAACGCGTGG	
1621	ATCCGGCTTA CTAAAAGCCA GATAACAGTA TGCGTATTTG CGCGCTGATT TTTGCGGTAT	
1681	AAGAATATAT ACTGATATGT ATACCCGAAG TATGTCAAAA AGAGGTGTGC TATGAAGCAG	
1741	CGTATTACAG TGACAGTTGA CAGCGACAGC TATCAGTTGC TCAAGGCATA TATGATGTCA	
1801	ATATCTCCGG TCTGGTAAGC ACAACCATGC AGAATGAAGC CCGTCGTCTG CGTGCCGAAC	
1861	GCTGGAAAAGC GGAAAATCAG GAAGGGATGG CTGAGGTCGC CCGGTTTATT GAAATGAACG	
1921	GCTCTTTTGC TGACGAGAAC AGGGACTGGT GAAATGCAGT TTAAGGTTTA CACCTATAAA	
1981	AGAGAGAGCC GTTATCGTCT GTTTGTGGAT GTACAGAGTG ATATTATTGA CACGCCCCGG	
2041	CGACGGATGG TGATCCCCCT GGCCAGTGCA CGTCTGCTGT CAGATAAAGT CTCCCGTGAA	
2101	CTTTACCCGG TGGTGATAT CCGGGATGAA AGCTGGCGCA TGATGACCAC CGATATGGCC	
2161	AGTGTGCCGG TCTCCGTTAT CCGGGAAGAA GTGGCTGATC TCAGCCACCG CGAAAATGAC	
2221	ATCAAAAACG CCATTAACCT GATGTTCTGG GGAATATAAA TGTCAAGCTC CCTTATACAC	
2281	AGCCAGTCTG CAGGTCGACC ATAGTGACTG GATATGTTGT GTTTTACAGT ATTATGTAGT	
2341	CTGTTTTTTA TGCAAAATCT AATTTAATAT ATTGATATTT ATATCATTTT ACGTTTCTCG	
2401	TTCAGCTTTT TTGTACAAAG TGGTGATTAT GAGCGATAAA ATTATTACAC TGACTGACGA	
2461	CAGTTTTGAC ACGGATGTAC TCAAAGCGGA CCGGGCGATC CTCGTCGATT TCTGGGCAGA	
2521	GTGGTGCGGT CCGTGCAAAA TGATCGCCCC GATTCTGGAT GAAATCGCTG ACGAATATCA	
2581	GGGCAAACTG ACCGTTGCAA AACTGAACAT CGATCAAAAC CCTGGCACTG CGCCGAAATA	
2641	TGGCATCCGT GGTATCCCGA CTCTGCTGCT GTTCAAAAAC GGTGAAGTGG CGGCAACCAA	
2701	AGTGGGTGCA CTGTCTAAAG GTCAGTTGAA AGAGTTCCTC GACGCTAACC TGGCCGGTTC	
2761	TGGTTCTGGT GATGACGATG ACAAGGTACC CCGGGATCGA TCCGGCTGCT AACAAAGCCC	

Figure 45B

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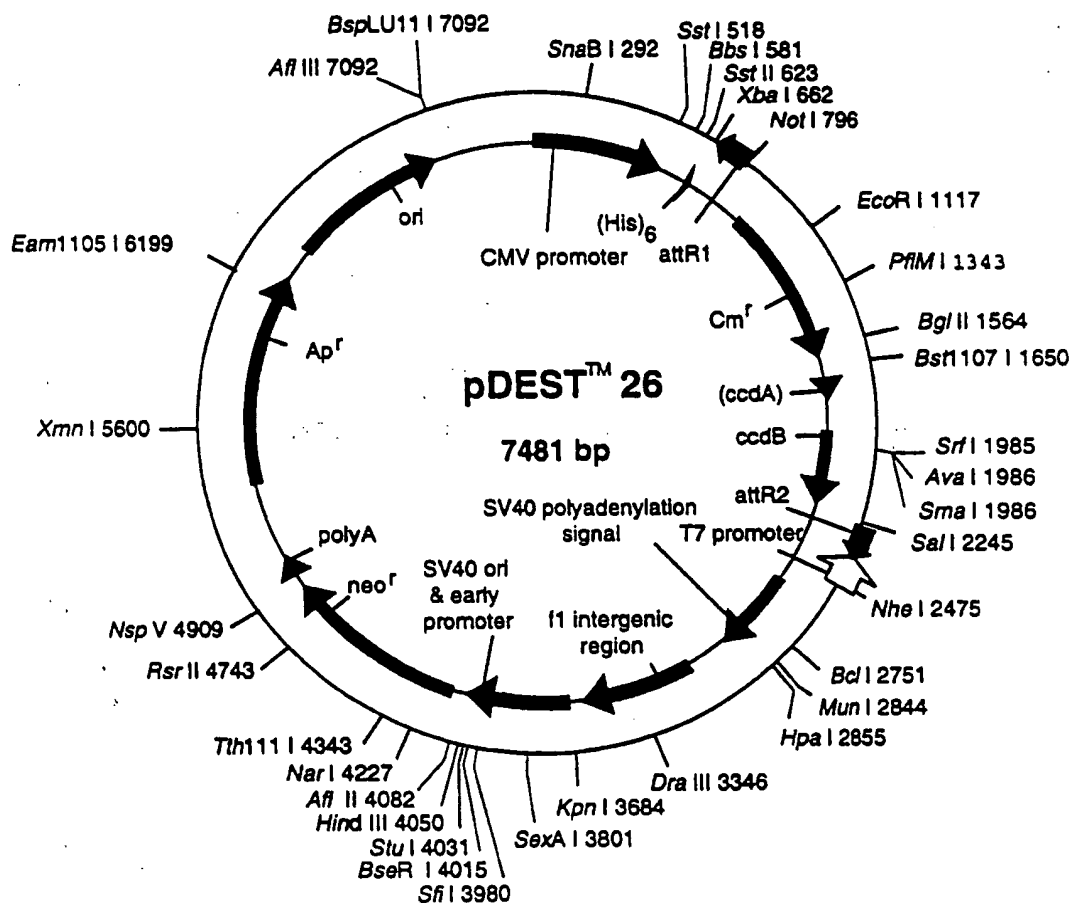
2821 GAAAGGAAGC TGAGTTGGCT GCTGCCACCG CTGAGCAATA ACTAGCATAA CCCCTTGGGG
2881 CCTCTAAACG GGTCTTGAGG GGTTTTTTGC TGAAAGGAGG AACTATATCC GGATATCCAC
2941 AGGACGGGTG TGGTCGCCAT GATCGCGTAG TCGATAGTGG CTCCAAGTAG CGAAGCGAGC
3001 AGGACTGGGC GCGGCCAAA GCGGTCGGAC AGTGCTCCGA GAACGGGTGC GCATAGAAAT
3061 TGCATCAACG CATATAGCGC TAGCAGCACG CCATAGTGAC TGGCGATGCT GTCGGAATGG
3121 ACGATATCCC GCAAGAGGCC CGGCAGTACC GGCATAACCA AGCCTATGCC TACAGCATCC
3181 AGGGTGACGG TGCCGAGGAT GACGATGAGC GCATTGTTAG ATTTCATACA CGGTGCCTGA
3241 CTGCGTTAGC AATTCTTAACTG TGATAAACTA CCGCATTAAA GCTTATCGAT GATAAGCTGT
3301 CAAACATGAG AATTCTTGAA GACGAAAGGG CCTCGTGATA CGCCTATTTT TATAGGTTAA
3361 TGTCATGATA ATAATGGTTT CTTAGACGTC AGGTGGCACT TTTCGGGGAA ATGTGCGCGG
3421 AACCCCTATT TGTTATTTT TCTAAATACA TTCAAATATG TATCCGCTCA TGAGACAATA
3481 ACCCTGATAA ATGCTTCAAT AATATTGAAA AAGGAAGAGT ATGAGTATTC AACATTTCCG
3541 TGTCGCCCTT ATTCCCTTTT TTGCGGCATT TTGCCTTCCT GTTTTTGCTC ACCCAGAAAC
3601 GCTGGTGAAA GTAAAGATG CTGAAGATCA GTTGGGTGCA CGAGTGGGT ACATCGAACT
3661 GGATCTCAAC AGCGGTAAGA TCCTTGAGAG TTTTCGCCCC GAAGAACGTT TTCCAATGAT
3721 GAGCACTTTT AAAGTTCTGC TATGTGGCGC GGTATTATCC CGTGTGTGACG CCGGGCAAGA
3781 GCAACTCGGT CGCCGCATAC ACTATTCTCA GAATGACTTG GTTGAGTACT CACCAGTCAC
3841 AGAAAAGCAT CTTACGGATG GCATGACAGT AAGAGAATTA TGCAGTGCTG CCATAACCAT
3901 GAGTGATAAC ACTCGGCCA ACTTACTTCT GACAACGATC GGAGGACCGA AGGAGCTAAC
3961 CGCTTTTTTG CACAACATGG GGGATCATGT AACTCGCCTT GATCGTTGGG AACCAGGAGCT
4021 GAATGAAGCC ATACCAAACG ACGAGCGTGA CACCACGATG CCTGCAGCAA TGGCAACAAC
4081 GTTGCAGCAA CTATTAACCTG GCGAACTACT TACTCTAGCT TCCCGGCAAC AATTAATAGA
4141 CTGGATGGAG GCGGATAAAG TTGCAGGACC ACTTCTGCGC TCGGCCCTTC CCGCTGGCTG
4201 GTTTATTGCT GATAAATCTG GAGCCGGTGA GCGTGGGTCT CGCGGTATCA TTGCAGCACT
4261 GGGGCAGAT GGTAAGCCCT CCCGTATCGT AGTTATCTAC ACGACGGGGA GTCAGGCAAC
4321 TATGGATGAA CGAAATAGAC AGATCGCTGA GATAGGTGCC TCACTGATTA AGCATTGGTA
4381 ACTGTCAGAC CAAGTTTACT CATATATACT TTAGATTGAT TTAAAACTTC ATTTTTAATT
4441 TAAAGGATC TAGGTGAAGA TCCTTTTTGA TAATCTCATG ACCAAAATCC CTTAAGCTGA
4501 GTTTTCGTTT CACTGAGCGT CAGACCCCGT AGAAAAGATC AAAGGATCTT CTTGAGATCC
4561 TTTTTTCTG CGCGTAATCT GCTGCTTGCA AACAAAAAAA CCACCGCTAC CAGCGGTGGT
4621 TTGTTTGCCG GATCAAGAGC TACCAACTCT TTTTCCGAAG GTAAGTGGCT TCAGCAGAGC
4681 GCAGATACCA AATACTGTCC TTCTAGTGTA GCCGTAGTTA GGCCACCACT TCAAGAACTC
4741 TGTCAGCCG CCTACATACC TCGCTCTGCT AATCCTGTTA CCAGTGGCTG CTGCCAGTGG
4801 CGATAAGTCG TGTCTTACCG GGTGAGCTC AAGACGATG TTACCGGATA AGGCGCAGCG
4861 GTCGGGTGTA ACGGGGGGT CAGTGCACACA GCCCAGCTTG GAGCGAACGA CCTACACCGA
4921 ACTGAGATAC CTACAGCGTG AGCTATGAGA AAGCGCCACG CTTCCCGAAG GGAGAAAGGC
4981 GGACAGGTAT CCGGTAAGCG GCAGGGTCGG AACAGGAGAG CGCACGAGGG AGCTTCCAGG
5041 GGGAAACGCC TGGTATCTTT ATAGTCCTGT CGGGTTTCGC CACCTCTGAC TTGAGCGTCG
5101 ATTTTTGTGA TGCTCGTCAG GGGGGCGGAG CCTATGAAA AACGCCAGCA ACGCGGCCTT
5161 TTTACGGTTC CTGGCCTTTT GCTGGCCTTT TGCTCACATG TTCTTTCTCG CTTTATCCCC
5221 TGATTCTGTG GATAACCGTA TTACCGCCTT TGAGTGAGCT GATACCGCTC CCGCGAGCCG
5281 AACGACCGAG CGCAGCGAGT CAGTGAGCGA GGAAGCGGAA GAGCGCCTGA TCGGGTATTT
5341 TCTCCTTACG CATCTGTGCG GTATTTTACA CCGCATATAT GGTGCACTCT CAGTACAATC
5401 TGCTCTGATG CCGCATAGTT AAGCCAGTAT AACTCCGCT ATCGCTACGT GACTGGGTCA
5461 TGGCTGCGCC CCGACACCCG CCAACACCCG CTGACGCGCC CTGACGGGCT TGTCTGCTCC
5521 CGGCATCCGC TTACAGACAA GCTGTGACCG TCTCCGGGAG CTGCATGTGT CAGAGGTTTT
5581 CACCGTCATC ACCGAAACGC GCGAGGCAGC TGCGGTAAAG CTCATCAGCG TGGTCGTGAA
5641 GCGATTACCA GATGTCTGCC TGTTTCATCCG CGTCCAGCTC GTTGAGTTTC TCCAGAAGCG
5701 TTAATGTCTG GCTTCTGATA AAGCGGGCCA TGTTAAGGGC GGTTTTTTTC TGTTTGGTCA
5761 CTGATGCCTC CGTGTAAGGG GGATTTCTGT TCATGGGGGT AATGATAACG ATGAAACGAG
5821 AGAGGATGCT CACGATACGG GTTACTGATG ATGAACATGC CCGGTTACTG GAACGTTGTG
5881 AGGGTAAACA ACTGGCGGTA TGGATGCGGC GGGACCAGAG AAAAATCACT CAGGGTCAAT
5941 GCCAGCGCTT CGTTAATACA GATGTAGGTG TTCCACAGGG TAGCCAGCAG CATCCTGCGA
6001 TGCAGATCCG GAACATAATG GTGCAGGGCG CTGACTTCCG CGTTTCCAGA CTTTACGAAA
6061 CACGGAAACC GAAGACCATT CATGTTGTTG CTCAGGTCGC AGACGTTTTG CAGCAGCAGT
6121 CGCTTCACGT TCGCTCGCGT ATCGGTGATT CATTCTGCTA ACCAGTAAGG CAACCCCGCC
6181 AGCCTAGCCG GGTCCTCAAC GACAGGAGCA CGATCATGCG CACCCGTGGC CAGGACCCAA
6241 CGCTGCCCCG GATGCGCCGC GTGCGGCTGC TGGAGATGGC GGACGCGATG GATATGTTCT

FIGURE 45C

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6301 GCCAAGGGTT GGTTCGCGCA TTCACAGTTC TCCGCAAGAA TTGATTGGCT CCAATTCTTG
6361 GAGTGGTGAA TCCGTTAGCG AGGTGCCGCC GGCTTCCATT CAGGTCGAGG TGGCCCGGCT
6421 CCATGCACCG CGACGCAACG CGGGGAGGCA GACAAGGTAT AGGGCGGCGC CTACAATCCA
6481 TGCCAACCCG TTCCATGTGC TCGCCGAGGC GGCATAAATC GCCGTGACGA TCAGCGGTCC
6541 AGTGATCGAA GTTAGGCTGG TAAGAGCCGC GAGCGATCCT TGAAGCTGTC CCTGATGGTC
6601 GTCATCTACC TGCCTGGACA GCATGGCCTG CAACGCGGGC ATCCCGATGC CG

FIGURE 45D



pDEST26 7481 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
492..509		his6
619..519		attR1
752..1411		CmR
1531..1615		inactivated ccdA
1753..2058		ccdB
2099..2223		attR2
2409..2771		SV40 polyA
2966..3421		f1 intergenic region
3485..3903		SV40 promoter
3948..4742		neo
4806..4854		polyA
5265..6125		Apr
6274..6913		ori
7344..385		CMV promoter

1	GTAAACTGCC	CACTTGGCAG	TACATCAAGT	GTATCATATG	CCAAGTACGC	CCCCTATTGA
61	CGTCAATGAC	GGTAAATGGC	CCGCCTGGCA	TTATGCCCAG	TACATGACCT	TATGGGACTT
121	TCCTACTTGG	CAGTACATCT	ACGTATTAGT	CATCGCTATT	ACCATGGTGA	TGCGGTTTTG
181	GCAGTACATC	AATGGGCGTG	GATAGCGGTT	TGACTCACGG	GGATTTCCAA	GTCTCCACCC
241	CATTGACGTC	AATGGGAGTT	TGTTTTGGCA	CCAAATCAA	CGGGACTTTC	CAAAATGTCT
301	TAACAACTCC	GCCCCATTGA	CGCAAATGGG	CGGTAGGCGT	GTACGGTGGG	AGGTCTATAT
361	AAGCAGAGCT	CGTTTAGTGA	ACCGTCAGAT	CGCCTGGAGA	CGCCATCCAC	GCTGTTTTGA
421	CCTCCATAGA	AGACACCGGG	ACCGATCCAG	CCTCCGGACT	CTAGCCTAGG	CCGCGGACCA
481	TGGCGTACTA	CCATCACCAT	CACCATCACT	CTAGATCAAC	AAGTTTGTAC	AAAAAAGCTG
541	AACGAGAAAC	GTAAAATGAT	ATAAATATCA	ATATATTAAA	TTAGATTTTG	CATAAAAAAC
601	AGACTACATA	ATACTGTAAA	ACACAACATA	TCCAGTCACT	ATGGCGGCCG	CATTAGGCAC
661	CCCAGGCTTT	ACACTTTATG	CTTCCGGCTC	GTATAATGTG	TGGATTTTGA	GTTAGGATCC
721	GGCGAGATTT	TCAGGAGCTA	AGGAAGCTAA	AATGGAGAAA	AAAATCACTG	GATATACCAC
781	CGTTGATATA	TCCAATGGC	ATCGTAAAGA	ACATTTTGAG	GCATTTTCACT	CAGTTGCTCA
841	ATGTACCTAT	AACCAGACCG	TTCAGCTGGA	TATTACGGCC	TTTTTAAAGA	CCGTAAAGAA
901	AAATAAGCAC	AAGTTTATC	CGGCCTTTAT	TCACATTCTT	GCCCGCCTGA	TGAATGCTCA
961	TCCGGAATTC	CGTATGGCAA	TGAAAGACGG	TGAGCTGGTG	ATATGGGATA	GTGTTACCCC
1021	TTGTTACACC	GTTTTCCATG	AGCAAATGTA	AACGTTTTCA	TCGCTCTGGA	GTGAATACCA
1081	CGACGATTTT	CGGCAGTTTC	TACACATATA	TTGCAAGAT	GTGGCGTGTT	ACGGTGAAAA
1141	CCTGGCCTAT	TTCCTTAAAG	GGTTTATTGA	GAATATGTTT	TTGCTCTCAG	CCAATCCCTG
1201	GGTGAGTTTC	ACCAGTTTTC	ATTTAAACGT	GGCCAATATG	GACAACCTCT	TCGCCCCCGT
1261	TTTACCATATG	GGCAAATATT	ATACGCAAGG	CGACAAGGTG	CTGATGCCGC	TGGCGATTCA
1321	GGTTCATCAT	GCCGCTCTGT	ATGGCTTCCA	TGTCGGCAGA	ATGCTTAATG	AATTACAACA
1381	GTACTGCGAT	GAGTGGCAGG	GCGGGGCGTA	AAGATCTGGA	TCCGGCTTAC	TAAAAGCCAG
1441	ATAACAGTAT	GCGTATTTGC	GCGCTGATTT	TTGCGGTATA	AGAATATATA	CTGATATGTA
1501	TACCCGAAGT	ATGTCAAAAA	GAGGTGTGCT	ATGAAGCAGC	GTATTACAGT	GACAGTTGAC
1561	AGCGACAGCT	ATCAGTTGCT	CAAGGCATAT	ATGATGTCAA	TATCTCCGGT	CTGGTAAGCA
1621	CAACCATGCA	GAATGAAGCC	CGTCGTCTGC	GTGCCGAACG	CTGGAAAGCG	GAAAATCAGG
1681	AAGGGATGGC	TGAGGTCGCC	CGGTTTATTG	AAATGAACGG	CTCTTTTGCT	GACGAGAACA
1741	GGGACTGGTG	AAATGCAGTT	TAAGGTTTAC	ACCTATAAAA	GAGAGAGCCG	TTATCGTCTG
1801	TTTGTGGATG	TACAGAGTGA	TATTATTGAC	ACGCCCCGGC	GACGGATGGT	GATCCCCCTG
1861	GCCAGTGCAC	GTCTGTCTGT	AGATAAAGTC	TCCCGTGAAC	TTTACCCGGT	GGTGCATATC
1921	GGGGATGAAA	GCTGGCGCAT	GATGACCACC	GATATGGCCA	GTGTGCCGGT	CTCCGTTATC
1981	GGGGAAGAAG	TGGCTGATCT	CAGCCACCGC	GAAAATGACA	TCAAAAACGC	CATTAACCTG
2041	ATGTTCTGGG	GAATATAAAT	GTCAGGCTCC	CTTATACACA	GCCAGTCTGC	AGGTCGACCA
2101	TAGTGACTGG	ATATGTTGTG	TTTTACAGTA	TTATGTAGTC	TGTTTTTTAT	GCAAAAATCTA
2161	ATTTAATATA	TTGATATTTA	TATCATTTTA	CGTTTTCTCGT	TCAGCTTTCT	TGTACAAAGT
2221	GGTTGATCGC	GTGCATGCGA	CGTCATAGCT	CTCTCCCTAT	AGTGAGTCGT	ATTATAAGCT
2281	AGGCACTGGC	CGTCGTTTTA	CAACGTCGTG	ACTGGGAAAA	CTGCTAGCTT	GGGATCTTTG --

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2341 TGAAGGAACC TTACTTCTGT GGTGTGACAT AATTGGACAA ACTACCTACA GAGATTTAAA
2401 GCTCTAAGGT AAATATAAAA TTTTAAAGTG TATAATGTGT TAAACTAGCT GCATATGCTT
2461 GCTGCTTGAG AGTTTGTGCTT ACTGAGTATG ATTTATGAAA ATATTATACA CAGGAGCTAG
2521 TGATTCTAAT TGTTTGTGTA TTTTAGATTC ACAGTCCCAA GGCTCATTTT AGGCCCCCTCA
2581 GTCCTCACAG TCTGTTCATG ATCATAATCA GCCATACCAC ATTTGTAGAG GTTTTACTTG
2641 CTTTAAAAAA CCTCCACAC CTCCCCCTGA ACCTGAAACA TAAAATGAAT GCAATTGTTG
2701 TTGTTAACTT GTTTATTGCA GCTTATAATG GTTACAAATA AAGCAATAGC ATCACAAATT
2761 TCACAAATAA AGCATTTTTT TCACTGCATT CTAGTTGTGG TTTGTCCAAA CTCATCAATG
2821 TATCTTATCA TGTCTGGATC GATCCTGCAT TAATGAATCG GCCAACGCGC GGGGAGAGGC
2881 GGTTCGCGTA TTGGCTGGCG TAATAGCGAA GAGGCCCGCA CCGATCGCCC TCCCAACAG
2941 TTGCGCAGCC TGAATGGCGA ATGGGACGCG CCCTGTAGCG GCGCATTAAG CGCGCGGGT
3001 GTGGTGGTTA CGCGCAGCGT GACCGCTACA CTTGCCAGCG CCCTAGCGCC CGCTCCTTTC
3061 GCTTCTTCC CTTCTTTCT CGCCACGTTT GCCGCTTTC CCCGTCAAGC TCTAAATCGG
3121 GGGCTCCCTT TAGGGTCCG ATTTAGTGCT TTACGGCACC TCGACCCCAA AAAACTTGAT
3181 TAGGGTGATG GTTCACGTAG TGGGCCATCG CCCTGATAGA CGGTTTTTCG CCCTTGACG
3241 TTGGAGTCCA CGTCTTTTAA TAGTGGACTC TTGTTCCAAA CTGGAACAAC ACTCAACCCT
3301 ATCTCGGTCT ATTCTTTTGA TTTATAAGGG ATTTTGCCGA TTTCGGCCTA TTGGTTAAAA
3361 AATGAGCTGA TTTAACAAT ATTTACGCG AATTTTAAACA AAATATTAAC GTTTACAATT
3421 TCGCCTGATG CGGTATTTTC TCCTTACGCA TCTGTGCGGT ATTTACACACC GCATACGCGG
3481 ATCTGCGCAG CACCATGGCC TGAAATAACC TCTGAAAGAG GAACTTGGTT AGGTACCTTC
3541 TGAGGCGGAA AGAACCAGCT GTGGAATGTG TGTAGTTAG GGTGTGAAA GTCCCCAGGC
3601 TCCCCAGCAG GCAGAAGTAT GCAAAGCATG CATCTCAATT AGTCAGCAAC CAGGTGTGGA
3661 AAGTCCCCAG GCTCCCCAGC AGGCAGAAGT ATGCAAAGCA TGCACTCAA TTAGTCAGCA
3721 ACCATAGTCC CGCCCCAAC TCCGCCCATC CCGCCCCCTAA CTCCGCCAG TTCCGCCCAT
3781 TCTCCGCCCC ATGGCTGACT AATTTTTTTT ATTTATGCAG AGGCCGAGGC CGCCTCGGCC
3841 TCTGAGCTAT TCCAGAAAGTA GTGAGGAGGC TTTTGTGGAG GCCTAGGCTT TTGCAAAAAG
3901 CTTGATTCTT CTGACACAAC AGTCTCGAAC TTAAGGCTAG AGCCACCATG ATTGAACAAG
3961 ATGGATTGCA CGCAGGTTCT CCGGCCGCTT GGGTGGAGAG GCTATTCGGC TATGACTGGG
4021 CACAACAGAC AATCGGCTGC TCTGATGCCG CCGTGTTCG GCTGTCAGCG CAGGGGCGCC
4081 CGGTTCTTTT TGTCAGACC GACCTGTCCG GTGCCCTGAA TGAAGTCAG GACGAGGCAG
4141 CGCGGCTATC GTGGCTGGCC ACGACGGGCG TTCCTTGCGC AGCTGTGCTC GACGTTGTCA
4201 CTGAAGCGGG AAGGGACTGG CTGCTATTGG GCGAAGTGCC GGGGAGGAT CTCCTGTCAT
4261 CTCACCTTGC TCCTGCCGAG AAAGTATCCA TCATGGCTGA TGCAATGCGG CGGCTGCATA
4321 CGCTTGATCC GGCTACCTGC CCATTGACC ACCAAGCGAA ACATCGCATC GAGCGAGCAC
4381 GTRACTCGGAT GGAAGCCGGT CTTGTGCATC AGGATGATCT GGACGAAGAG CATCAGGGGC
4441 TCGCGCCAGC CGAACTGTTT GCCAGGCTCA AGGCGCGCAT GCCCGACGGC GAGGATCTCG
4501 TCGTGACCCA TGGCGATGCC TGCTTGCCGA ATATCATGGT GGAAAATGGC CGCTTTTCTG
4561 GATTCAATCGA CTGTGCCCGG CTGGGTGTGG CGGACCCTA TCAGGACATA GCGTTGGCTA
4621 CCGTGATAT TGCTGAAGAG CTTGGCGGCG AATGGGCTGA CCGCTTCTC GTGCTTTACG
4681 GTATCGCCGC TCCCGATTCT CAGCGCATCG CTTCTATCG CTTCTTGAC GAGTCTTCT
4741 GAGCGGACT CTGGGTTCTG AAATGACCGA CCAAGCGAGC CCCAACCTGC CATCACGATG
4801 GCCGCAATAA AATATCTTTA TTTTCATTAC ATCTGTGTGT TGGTTTTTTG TGTGAATCGA
4861 TAGCGATAAG GATCCGCGTA TGGTGCATC TCAGTACAAT CTGCTCTGAT GCCGCATAGT
4921 TAAGCCAGCC CCGACACCCG CCAACACCCG CTGACGCGCC CTGACGGGCT TGTCTGCTCC
4981 CGGCATCCGC TTACAGACAA GCTGTGACCG TCTCCGGGAG CTGCATGTGT CAGAGGTTTT
5041 CACCGTCATC ACCGAAACGC GCGAGACGAA AGGCCTCGT GATACGCCCTA TTTTATAGG
5101 TTAATGTATC GATAATAATG GTTCTTTAGA CGTCAGGTGG CACTTTTCCG GGAAATGTGC
5161 GCGGAACCCC TATTTGTTA TTTTCTAAA TACATTCAA TATGTATCCG CTCATGAGAC
5221 AATAACCTG ATAAATGCTT CAATAATATT GAAAAGGAA GAGTATGAGT ATTCAACATT
5281 TCCGTGTCCG CTTATTCCC TTTTGTGCG CATTGTGCT TCCTGTTTT GCTCACCAG
5341 AAACGCTGGT GAAAGTAAA GATGCTGAAG ATCAGTTGGG TGCACGAGT GGTACATCG
5401 AACTGGATCT CAACAGCGGT AAGATCCTTG AGAGTTTTCG CCCCAGAGAA CGTTTTCCAA
5461 TGATGAGCAC TTTTAAAGTT CTGCTATGTG GCGCGGTATT ATCCCGTATT GACGCCGGG
5521 AAGAGCAACT CGGTGCGCCG ATACACTATT CTCAGAATGA CTTGGTTGAG TACTACCAG
5581 TCACAGAAAA GCATCTTACG GATGGCATGA CAGTAAGAGA ATTATGCAGT GCTGCCATAA
5641 CCATGAGTGA TAACACTGCG GCCAACTTAC TTCTGACAAC GATCGGAGGA CCGAAGAGC
5701 TAACCGCTTT TTTGCACAAC ATGGGGGATC ATGTAACCTG CTTGATCGT TGGGAACCGG
5761 AGCTGAATGA AGCCATACCA AACGACGAGC GTGACACCAC GATGCCTGTA GCAATGGCAA -

FIGURE 46C

5821 CAACGTTGCG CAAACTATTA ACTGGCGAAC TACTTACTCT AGCTTCCCGG CAACAATTAA
5881 TAGACTGGAT GGAGGCGGAT AAAGTTGCAG GACCACTTCT GCGCTCGGCC CTTCCGGCTG
5941 GCTGGTTTAT TGCTGATAAA TCTGGAGCCG GTGAGCGTGG GTCTCGCGGT ATCATTGCAG
6001 CACTGGGGCC AGATGGTAAG CCTCCCCGTA TCGTAGTTAT CTACACGACG GGGAGTCAGG
6061 CAACTATGGA TGAACGAAAT AGACAGATCG CTGAGATAGG TGCCTCACTG ATTAAGCATT
6121 GGTAAGTGTG AGACCAAGTT TACTCATATA TACTTTAGAT TGATTTAAAA CTTCATTTTT
6181 AATTTAAAAG GATCTAGGTG AAGATCCTTT TTGATAATCT CATGACCAAA ATCCCTTAAC
6241 GTGAGTTTTT GTTCCACTGA GCGTCAGACC CCGTAGAAAA GATCAAAGGA TCTTCTTGAG
6301 ATCCTTTTTT TCTGCGCGTA ATCTGCTGCT TGCAAACAAA AAAACCACCG CTACCAGCGG
6361 TGGTTTGTGT GCGGATCAA GAGCTACCAA CTCTTTTCC GAAGGTAAGT GGCTTCAGCA
6421 GAGCGCAGAT ACCAAATACT GTCTTCTAG TGTAGCCGTA GTTAGGCCAC CACTTCAAGA
6481 ACTCTGTAGC ACCGCTACA TACCTCGCTC TGCTAATCCT GTTACCAGTG GCTGCTGCCA
6541 GTGGCGATAA GTCGTGTCTT ACCGGGTTGG ACTCAAGACG ATAGTTACCG GATAAGGCGC
6601 AGCGGTCGGG CTGAACGGGG GGTTCGTGCA CACAGCCCAG CTTGGAGCGA ACGACCTACA
6661 CCGAACTGAG ATACCTACAG CGTGAGCATT GAGAAAGCGC CACGCTTCCC GAAGGGAGAA
6721 AGGCGGACAG GTATCCGGTA AGCGGCAGGG TCGGAACAGG AGAGCGCACG AGGGAGCTTC
6781 CAGGGGGAAA CGCCTGGTAT CTTTATAGTC CTGTCGGGTT TCGCCACCTC TGACTTGAGC
6841 GTCGATTTTT GTGATGCTCG TCAGGGGGGC GGAGCCTATG GAAAAACGCC AGCAACGCGG
6901 CCTTTTTACG GTTCTTGCC TTTTGCTGGC CTTTGTCTCA CATGTTCTTT CCTGCGTTAT
6961 CCCCTGATTC TGTGGATAAC CGTATTACCG CCTTTGAGTG AGCTGATACC GCTCGCCGCA
7021 GCCGAACGAC CGAGCGCAGC GAGTCAGTGA GCGAGGAAGC GGAAGAGCGC CCAATACGCA
7081 AACCGCCTCT CCCC GC CGT TGGCCGATTC ATTAATGCAG AGCTTGCAAT TCGCGCGTTT
7141 TTCAATATTA TTGAAGCATT TATCAGGGTT ATTGTCTCAT GAGCGGATAC ATATTTGAAT
7201 GTATTTAGAA AAATAACAA ATAGGGGTT CCGGCACATT TCCCCGAAAA GTGCCACCTG
7261 ACGTCTAAGA AACCATTATT ATCATGACAT TAACCTATAA AAATAGGCGT AGTACGAGGC
7321 CCTTTCACCTC ATTAGATGCA TGTCGTTACA TAACTTACGG TAAATGGCCC GCCTGGCTGA
7381 CCGCCCAACG ACCCCCCGCC ATTGACGTCA ATAATGACGT ATGTTCCCAT AGTAACGCCA
7441 ATAGGGACTT TCCATTGACG TCAATGGGTG GAGTATTTAC G

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FIGURE 47A

pDEST 27 GST Amino Fusion in pCMV Sport-neo Vector

CMV Promoter

600 // nac ggt ggg agg tct ata taa gca gag ctc gtt tag tga acc gtc aga tcy
ntg cca ccc tcc aga tar att cgt ctc gag caa atc act tgg dag tct ago

651 cct gga gac gcc atc cac gct gtt ttg acc tcc ata gaa gac acc ggg acc
gga cct ctg cgg tag gtg cga caa aac tgg agg tat ctt ctg tgg ccc tgg

702 gat cca gcc tcc gga ctc tag cct agg ccg cgg acc atg gcc cct ata ata
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Start Transin GST

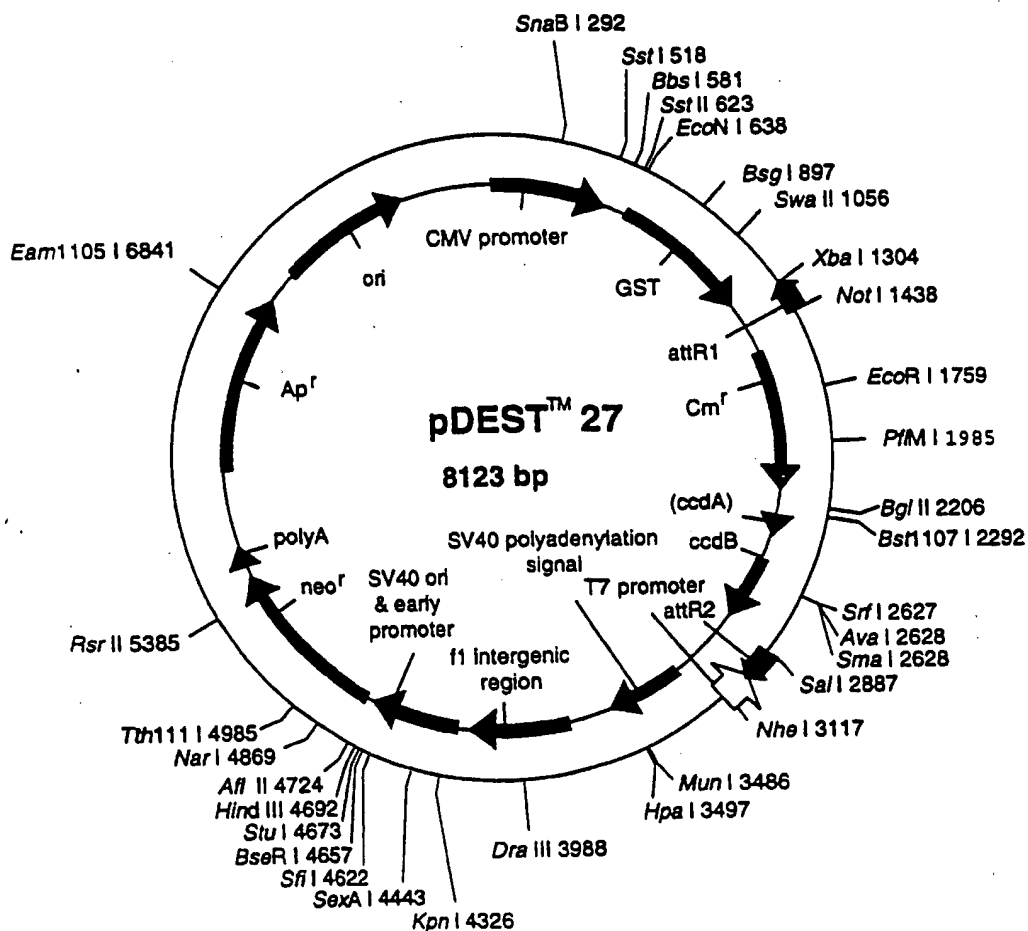
753 ggt tat tgy aaa att aag ggc ctt gtg caa ccc act aga ctt ctt ttg gaa
cca ata acc ttt taa ttc ccg gaa cac gtt ggg tga gct gaa gaa aac ctt

804 tat ctt gaa gaa aaa tat gaa gag cat ttg tat gag cgc gat gaa ggt gat
ata gaa ctt ctt ttt ata ctt ctc gta aac ata ctc ggc cta ctt cca cta

1365 // ttt ggt ggt ggc gac cat cct cca aaa tcy gat ctg gtt ccg cgt tct aga
aaa cca cca ccg ctg gta gga ggt ttt ago cta gac caa ggc gca aga tct

1416 S T S L Y K R A
tca aca agt ttg tac aaa aaa gct gaa cga gaa acg
agt tgt tca aac atg ttg ttt cga ctt cct ctt tgc

Int attR1



pDEST27 8123 bp (rotated to position 7800)

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
130..793	GST
803..927	attR1
1036..1695	CmR
1815..1899	inactivated ccdA
2037..2342	ccdB
2383..2507	attR2
2693..3055	SV40 polyA
3250..3705	f1 intergenic region
3769..4187	SV40 promoter
4232..5026	neo
5090..5138	polyA
5549..6409	Apr
6558..7197	ori
7628..27	CMV promoter

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1 ATAAGCAGAG CTCGTTTAGT GAACCGTCAG ATCGCCTGGA GACGCCATCC ACGCTGTTTT
61 GACCTCCATA GAAGACACCG GGACCGATCC AGCCTCCGGA CTCTAGCCTA GGCCGCGGAC
121 CATGGCCCCCT ATACTAGGTT ATTGGAATAA TAAGGGCCTT GTGCAACCCA CTCGACTTCT
181 TTTGGAATAT CTTGAAGAAA AATATGAAGA GCATTTGTAT GAGCGCGATG AAGGTGATAA
241 ATGGCGAAAC AAAAAGTTTG AATTGGGTTT GGAGTTTCCC AATCTTCCTT ATTATATTGA
301 TGGTGATGTT AAATTAACAC AGTCTATGGC CATCATACGT TATATAGCTG ACAAGCACAA
361 CATGTTGGGT GGTGTCCAA AAGAGCGTGC AGAGATTTCA ATGCTTGAAG GAGCGGTTTT
421 GGATATTAGA TACGGTGTTT CGAGAATTGC ATATAGTAAA GACTTTGAAA CTCTCAAAGT
481 TGATTTTCTT AGCAAGCTAC CTGAAATGCT GAAAATGTTT GAAGATCGTT TATGTCATAA
541 AACATATTTA AATGGTGATC ATGTAACCCA TCCTGACTTC ATGTTGTATG ACGCTCTTGA
601 TGTGTTTTTA TACATGGACC CAATGTGCCT GGATGCGTTC CCAAAATTAG TTTGTTTTAA
661 AAAACGTATT GAAGCTATCC CACAAATTGA TAAGTACTTG AAATCCAGCA AGTATATAGC
721 ATGGCCCTTG CAGGGCTGGC AAGCCACGTT TGGTGGTGGC GACCATCCTC CAAAATCGGA
781 TCTGGTTCCG CGTTCTAGAT CAACAAGTTT GTACAAAAAA GCTGAACGAG AAACGTAAAA
841 TGATATAAAT ATCAATATAT TAAATTAGAT TTTGCATAAA AAACAGACTA CATAATACTG
901 TAAAACACAA CATATCCAGT CACTATGGCG GCCGCATTAG GCACCCAGG CTTTACACTT
961 TATGCTTCCG GCTCGTATAA TGTGTGGATT TTGAGTTAGG ATCCGGCGAG ATTTTCAGGA
1021 GCTAAGGAAG CTAAAATGGA GAAAAAATC ACTGGATATA CCACCGTTGA TATATCCCAA
1081 TGGCATCGTA AAGAACATTT TGAGGCATTT CAGTCAGTTG CTCAATGTAC CTATAACCAAG
1141 ACCGTTCCAGC TGGATATTAC GGCCTTTTTT AAGACCGTAA AGAAAAATAA GCACAAGTTT
1201 TATCCGGCCT TTATTCACAT TCTTGCCCGC CTGATGAATG CTCATCCGGA ATTCCGTATG
1261 GCAATGAAAG ACGGTGAGCT GGTGATATGG GATAGTGTTC ACCCTTGTTA CACCGTTTTT
1321 CATGAGCAAA CTGAAACGTT TTCATCGCTC TGGAGTGAAT ACCACGACGA TTTCCGGCAG
1381 TTTCTACACA TATATTCGCA AGATGTGGCG TGTTACGGTG AAAACCTGGC CTATTTCCCT
1441 AAAGGGTTTA TTGAGAATAT GTTTTTCGTC TCAGCCAATC CCTGGGTGAG TTTACCAGT
1501 TTTGATTTAA ACGTGGCCAA TATGGACAAC TTCTTCGCCC CCGTTTTTAC CATGGGCAAA
1561 TATTATACGC AAGGCGACAA GGTGCTGATG CCGCTGGCGA TTCAGGTTCA TCATGCCGTC
1621 TGTGATGGCT TCCATGTCGG CAGAATGCTT AATGAATTAC AACAGTACTG CGATGAGTGG
1681 CAGGGCGGGG CGTAAAGATC TGGATCCGGC TTAATAAAAG CCAGATAACA GTATGCGTAT
1741 TTGCGCGCTG ATTTTTCGCG TATAAGAATA TATACTGATA TGTATACCCG AAGTATGTCA
1801 AAAAGAGGTG TGCTATGAAG CAGCGTATTA CAGTGACAGT TGACAGCGAC AGCTATCAGT
1861 TGCTCAAGGC ATATATGATG TCAATATCTC CGGTCTGGTA AGCACAACCA TGCAGAATGA
1921 AGCCCGTCGT CTGCGTGCCG AACGCTGGAA AGCGGAAAAT CAGGAAGGGA TGGCTGAGGT
1981 CGCCCGGTTT ATTGAAATGA ACGGCTCTTT TGCTGACGAG AACAGGGACT GGTGAAATGC
2041 AGTTTAAAGT TTACACCTAT AAAAGAGAGA GCCGTTATCG TCTGTTTGTG GATGTACAGA
2101 GTGATATTAT TGACACGCCC GGGCGACGGA TGGTGATCCC CCTGGCCAGT GCACGTCTGC
2161 TGTCAGATAA AGTCTCCCGT GAACTTTACC CGGTGGTGCA TATCGGGGAT GAAAGCTGGC
2221 GCATGATGAC CACCGATATG GCCAGTGTGC CGGTCTCCGT TATCGGGGAA GAAGTGGCTG
2281 ATCTCAGCCA CCGCGAAAAT GACATCAAAA ACGCCATTAA CCTGATGTTC TGGGGAATAT —

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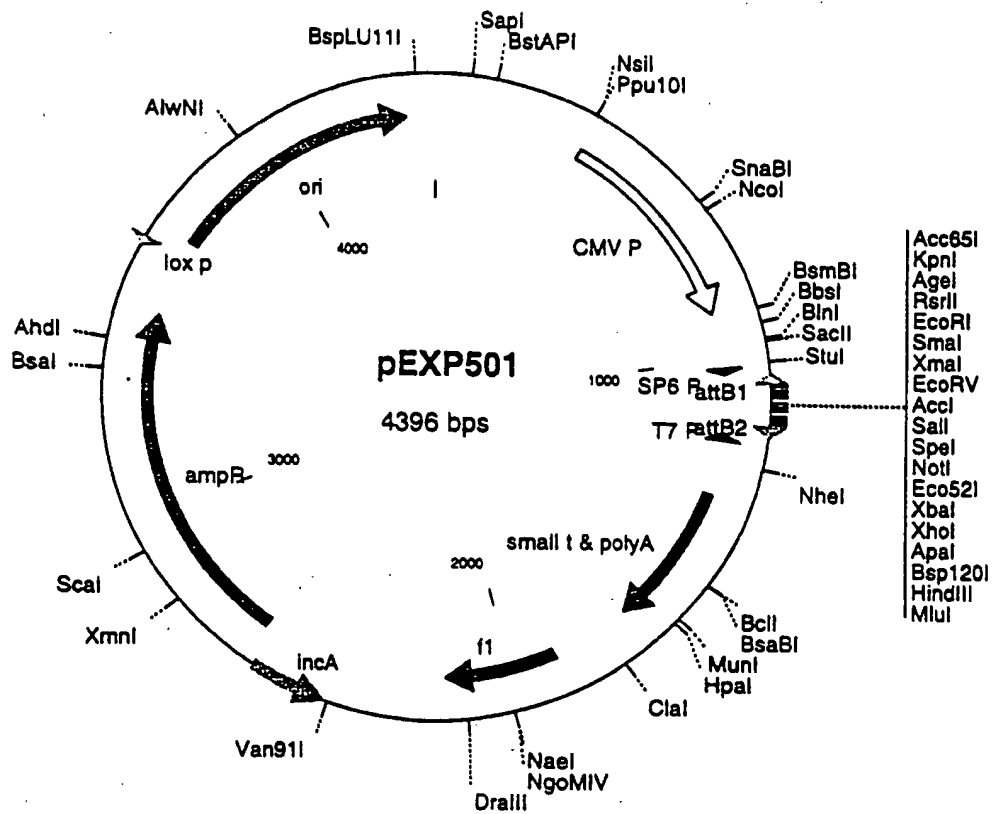
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2461 TTTATATCAT TTTACGTTTC TCGTTCAGCT TTCTTGATACA AAGTGGTTGA TCGCGTGCAT
2521 GCGACGTCAT AGCTCTCTCC CTATAGTGAG TCGTATTATA AGCTAGGCAC TGGCCGTCGT
2581 TTTACAACGT CGTGACTGGG AAAACTGCATA GCTTGGGATC TTTGTGAAGG AACCTTACTT
2641 CTGTGGTGTG ACATAATTGG ACAAACTACC TACAGAGATT TAAAGCTCTA AGGTAAATAT
2701 AAAATTTTTA AGTGATAAAT GTGTTAAACT AGCTGCATAT GCTTGCTGCT TGAGAGTTTT
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2821 TGTATTTTAG ATTCACAGTC CCAAGGCTCA TTTCAGGCCC CTCAGTCTCT ACAGTCTGTT
2881 CATGATCATA ATCAGCCATA CCACATTTGT AGAGGTTTTA CTGCTTTAA AAAACCTCCC
2941 ACACCTCCCC CTGAACCTGA AACATAAAAT GAATGCAATT GTTGTGTTA ACTTGTTTAT
3001 TGCAGCTTAT AATGGTTACA AATAAAGCAA TAGCATCACA AATTTCACAA ATAAAGCATT
3061 TTTTTCACGT CATTCTAGTT GTGGTTTGTC CAAACTCATC AATGTATCTT ATCATGTCTG
3121 GATCGATCCT GCATTAATGA ATCGGCCAAC GCGCGGGGAG AGGCGGTTTG CGTATTGGCT
3181 GGCCTAATAG CGAAGAGGCC CGCACCGATC GCCCTTCCCA ACAGTTGCGC AGCCTGAATG
3241 GCGAATGGGA CGCGCCCTGT AGCGCCGATC TAAGCGCGGC GGGTGTGGTG GTTACGCGCA
3301 GCGTGACCGC TACACTTGCC AGCGCCCTAG CGCCCGCTCC TTTGCTTTT TTCCCTCTCT
3361 TTCTCGCCAC GTTTCGCGGC TTTCCCGTTC AAGCTCTAAA TCGGGGGCTC CCTTTAGGGT
3421 TCCGATTTAG TGCTTTACGG CACCTCGACC CCAAAAAACT TGATTAGGGT GATGGTTTAC
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3541 TTAATAGTGG ACTCTTGTTT CAAACTGGAA CAACACTCAA CCCTATCTCG GTCTATTCTT
3601 TTGATTTATA AGGGATTTTG CCGATTTTCG CCTATTGGTT AAAAAATGAG CTGATTTAAC
3661 AAATATTTAA CGCGAATTTT AACAAAATAT TAACGTTTAC AATTTCGCCT GATGCGGTAT
3721 TTTCTCCTTA CGCATCTGTG CGGTATTTCA CACCGCATAC GCGGATCTGC GCAGCACCAT
3781 GGCCTGAAAT AACCTCTGAA AGAGGAACTT GGTAGGTAC CTTCTGAGGC GGAAGAACC
3841 AGCTGTGGAA TGTGTGTCAG TTAGGGTGTG GAAAGTCCCC AGGCTCCCCA GCAGGCAGAA
3901 GTATGCAAG CATGCATCTC AATTAGTCAG CAACAGGTG TGGAAAGTCC CCAGGCTCCC
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4081 GACTAATTTT TTTTATTTAT GCAGAGGCCG AGGCCGCTC GGCCTCTGAG CTATTCCAGA
4141 AGTAGTGAGG AGGCTTTTTT GGAGGCCTAG GCTTTTGCAA AAAGCTTGAT TCTTCTGACA
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4561 CGAGAAAGTA TCCATCATGG CTGATGCAAT GCGGCGGCTG CATACGCTTG ATCCGGCTAC
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5041 TTCGAAATGA CCGACCAAGC GACGCCCAAC CTGCCATCAC GATGGCCGCA ATAAATATC
5101 TTTATTTTCA TTACATCTGT GTGTTGGTTT TTTGTGTGAA TCGATAGCGA TAAGGATCCG
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FIGURE 47C

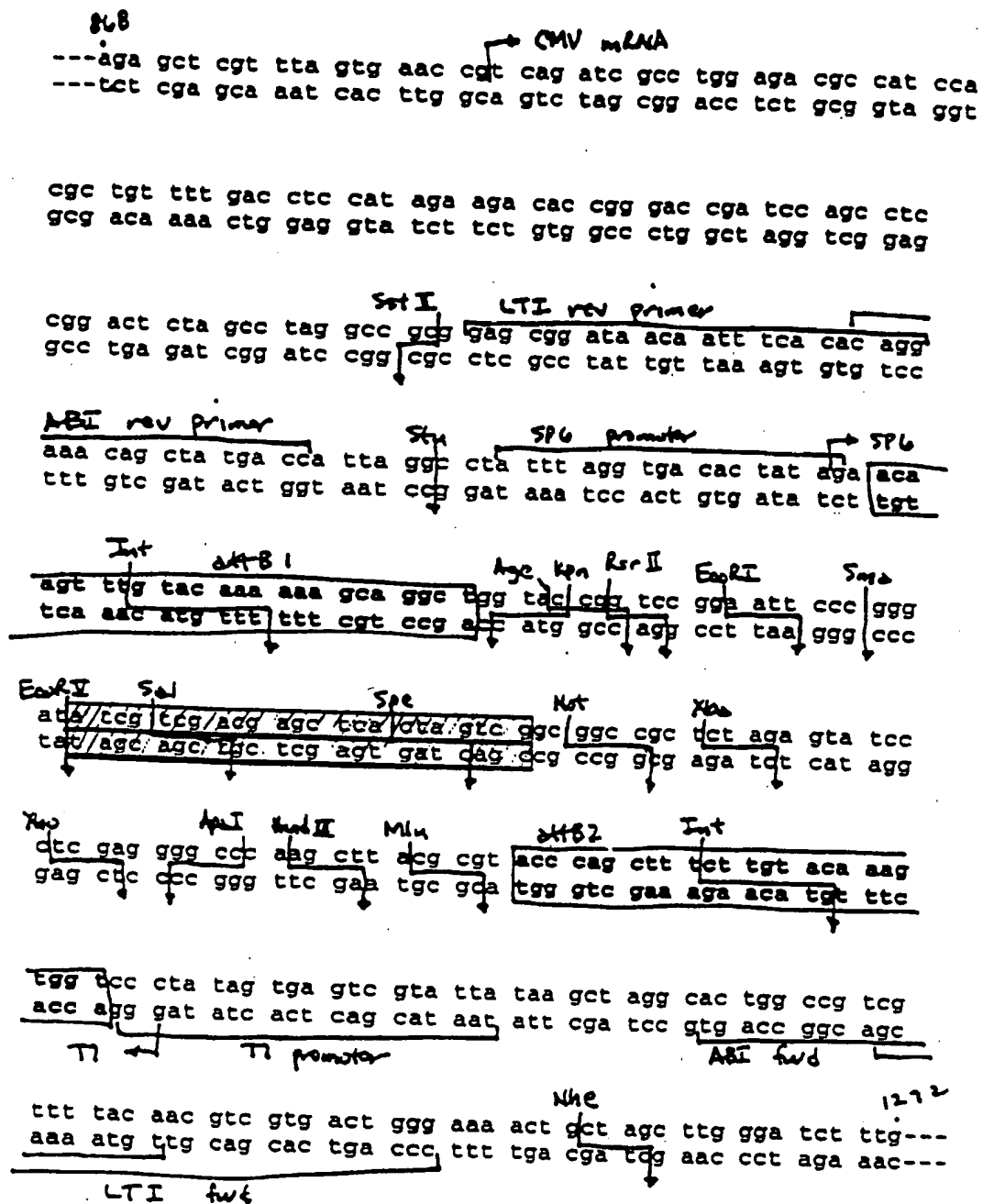
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6001 CAACATGGGG GATCATGTAA CTCGCCCTGA TCGTTGGGAA CCGGAGCTGA ATGAAGCCAT
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6541 CTGAGCGTCA GACCCCGTAG AAAAGATCAA AGGATCTTCT TGAGATCCTT TTTTCTGCG
6601 CGTAATCTGC TGCTTGCAAA CAAAAAACC ACCGCTACCA GCGGTGGTTT GTTTGCGGGA
6661 TCAAGAGCTA CCAACTCTTT TTCCGAAGGT AACTGGCTTC AGCAGAGCGC AGATACCAAA
6721 TACTGTCTTT CTAGTGTAGC CGTAGTTAGG CCACCACTTC AAGAACTCTG TAGCACCGCC
6781 TACATACCTC GCTCTGCTAA TCCTGTTACC AGTGGCTGCT GCCAGTGGCG ATAAGTCGTG
6841 TCTTACCGGG TTGGACTCAA GACGATAGTT ACCGGATAAG GCGCAGCGGT CGGGCTGAAC
6901 GGGGGGTTCC TGCACACAGC CCAGCTTGGG GCGAACGACC TACACCGAAC TGAGATACCT
6961 ACAGCGTGAG CATTGAGAAA GCGCCACGCT TCCCGAAGGG AGAAAGGCGG ACAGGTATCC
7021 GGTAAGCGGC AGGGTCGGAA CAGGAGAGCG CACGAGGGAG CTTCCAGGGG GAAACGCCTG
7081 GTATCTTTAT AGTCCTGTCG GGTTCGCCA CCTCTGACTT GAGCGTCGAT TTTTGTGATG
7141 CTCGTCAGGG GGGCGGAGCC TATGGAAAA CGCCAGCAAC GCGGCCTTTT TACGGTTCCT
7201 GGCCTTTTGC TGGCCTTTTG CTCACATGTT CTTTCCTGCG TTATCCCCTG ATTCTGTGGA
7261 TAACCGTATT ACCGCCTTTG AGTGAGCTGA TACCGCTCGC CGCAGCCGAA CGACCGAGCG
7321 CAGCGAGTCA GTGAGCGAGG AAGCGGAAGA GCGCCCAATA CGCAAACCGC CTCTCCCCGC
7381 GCGTTGGCCG ATTCATTAAT GCAGAGCTTG CAATTGCGC GTTTTTCAAT ATTATTGAAG
7441 CATTTATCAG GGTATTGTG TCATGAGCGG ATACATATTT GAATGTATTT AGAAAAATAA
7501 ACAAATAGGG GTTCCGCGCA CATTTCCCCG AAAAGTGCCA CCGTACGTCT AAGAAACCAT
7561 TATTATCATG ACATTAACCT ATAAAAATAG GCGTAGTACG AGGCCCTTTC ACTCATTAGA
7621 TGCATGTCGT TACATAACTT ACGGTAAATG GCGCGCCTGG CTGACCGCCC AACGACCCCC
7681 GCCCATTGAC GTCAATAATG ACGTATGTTT CCATAGTAAC GCCAATAGGG ACTTTCCATT
7741 GACGTCAATG GGTGGAGTAT TTACGGTAAA CTGCCCACTT GGCAGTACAT CAAGTGTATC
7801 ATATGCCAAG TACGCCCCCT ATTGACGTCA ATGACGGTAA ATGGCCCCG TGGCATTATG
7861 CCCAGTACAT GACCTTATGG GACTTTCCTA CTTGGCAGTA CATCTACGTA TTAGTCATCG
7921 CTATTACCAT GGTGATGCGG TTTTGGCAGT ACATCAATGG GCGTGGATAG CGGTTTGACT
7981 CACGGGGATT TCCAAGTCTC CACCCCATG ACGTCAATGG GAGTTTGTGTT TGGCACCAAA
8041 ATCAACGGGA CTTTCCAAAA TGTCGTAACA ACTCCGCCCC ATTGACGCAA ATGGGCGGTA
8101 GCGGTGTACG GTGGGAGGTC TAT

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Figure 4B A: pEXP501: pCMV.SPORT 6 host for attB Libraries

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Figure 4B: pEXP501 (cont'd). **Features of the att B cloning vector, pEXP501.** Bases within hatched area are replaced by cDNA in some LTI cDNA libraries.

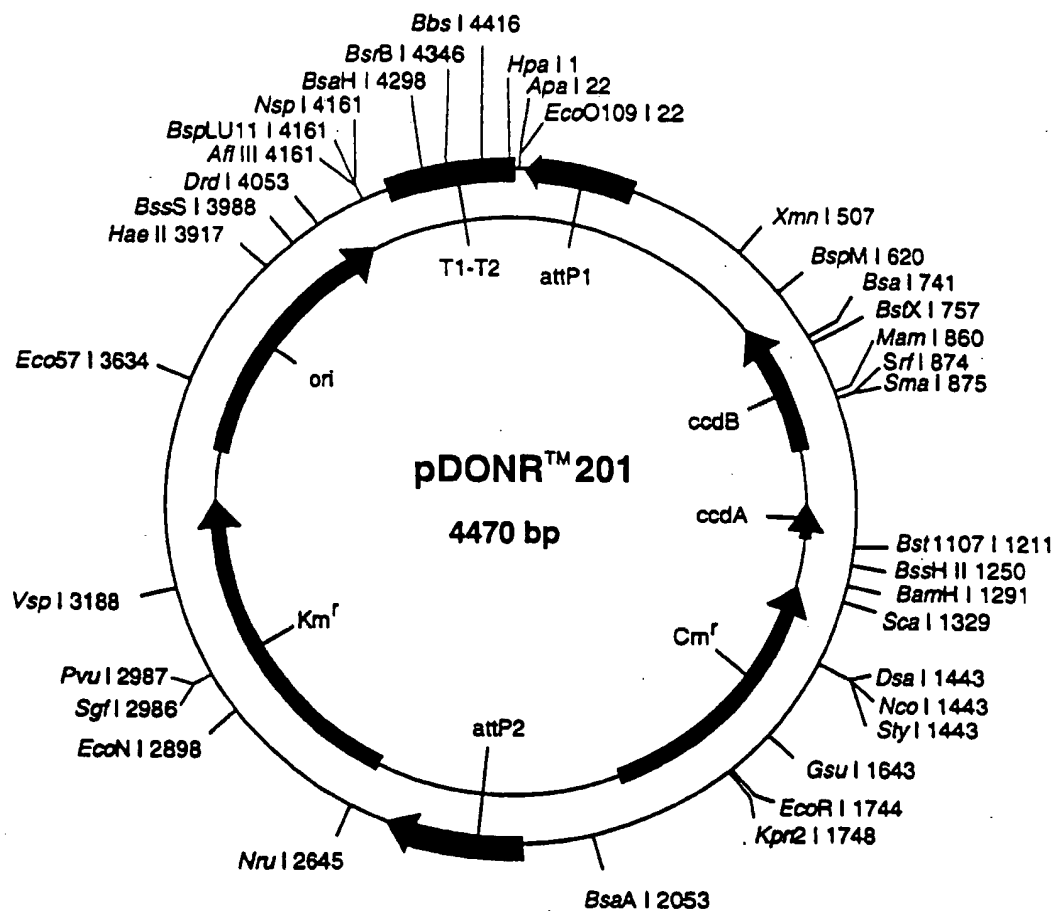


pEXP501 4396 bp

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1 CCATTCGCCA TTCAGGCTGC GCAACTGTTG GGAAGGGCGA TCGGTGCGGG CCTCTTCGCT
61 ATTACGCCAG CCAATACGCA AACCGCCTCT CCCCGCGCGT TGGCCGATTG ATTAATGCAG
121 GATCGATCCA GACATGATAA GATACATTGA TGAGTTTGGA CAAACCACAA CTAGAATGCA
181 GTGAAAAAAA TGCTTTATTT GTGAAATTG TGATGCTATT GCTTTATTTG TAACCATTAT
241 AAGCTGCAAT AAACAAGTTA ACAACAACAA TTGCATTCAAT TTTATGTTTC AGGTTTCAGGG
301 GGAGGTGTGG GAGGTTTTTT AAAGCAAGTA AAACCTCTAC AAATGTGGTA TGGCTGATTA
361 TGATCATGAA CAGACTGTGA GGACTGAGGG GCCTGAAATG AGCCTTGGGA CTGTGAATCT
421 AAAATACACA AACAATTAGA ATCACTAGCT CCTGTGTATA ATATTTTCAT AAATCATACT
481 CAGTAAGCAA AACTCTCAAG CAGCAAGCAT ATGCAGCTAG TTTAACACAT TATACACTTA
541 AAAATTTTAT ATTTACCTTA GAGCTTTAAA TCTCTGTAGG TAGTTTGTCC AATTATGTCA
601 CACCACAGAA GTAAGGTTCC TTCACAAAGA TCCCAAGCTA GCAGTTTTCC CAGTCACGAC
661 GTTGTAAAC GACGGCCAGT GCCTAGCTTA TAATACGACT CACTATAGGG ACCACTTTGT
721 ACAAGAAAGC TGGGTACGCG TAAGCTTGGG CCCCTCGAGG GATCCTCTAG AGCGGCCGCG
781 GACTAGTGAG CTCGTCGACG ATATCCCGGG AATTCCGGAC CGGTACCAGC CTGCTTTTTT
841 GTACAAACTT GTTCTATAGT GTCACCTAAA TAGGCCTAAT GGTACATAGT GTTTCCTGTG
901 TGAAATTGTT ATCCGCTCCG CGGCCTAGGC TAGAGTCCGG AGGCTGGATC GGTCCCGGTG
961 TCTTCTATGG AGGTCAAAAC AGCGTGGATG GCGTCTCCAG GCGATCTGAC GGTTCATAA
1021 ACGAGCTCTG CTTATATAGA CCTCCCACCG TACACGCCTA CCGCCCATTG GCGTCAATGG
1081 GCGGGAGTTG TTACGACATT TTGGAAAGTC CCGTTGATTT TGGTGCCAAA ACAAACTCCC
1141 ATTGACGTCA ATGGGGTGGG GACTTGGAAT TCCCCGTGAG TCAAACCGCT ATCCACGCCC
1201 ATTGATGTAC TGCCAAAACC GCATCACCAT GGTAAATAGCG ATGACTAATA CGTAGATGTA
1261 CTGCCAAGTA GGAAAGTCCC ATAAGGTCAT GTACTGGGCA TAATGCCAGG CGGGCCATTT
1321 ACCGTCATTG ACGTCAATAG GGGGCGTACT TGGCATATGA TACACTTGAT GTACTGCCAA
1381 GTGGGCAGTT TACCGTAAAT ACTCCACCCA TTGACGTCAA TGGAAAGTCC CTATTGGCGT
1441 TACTATGGGA ACATACGTCA TTATTGACGT CAATGGGCGG GGGTCGTTGG GCGGTCAGCC
1501 AGGCGGGCCA TTTACCGTAA GTTATGTAAAC GACATGCATC TAATGAGTGA AAGGGCCTCG
1561 TACTACGCCT ATTTTATAG GTTAATGTCA TGATAATAAT GGTTTCTTAG ACGTCAGGTG
1621 GCACTTTTCG GGGAAATGTG CGCGGAACCC CTATTTGTTT ATTTTCTAA ATACATTCAA
1681 ATATGTATCC GCTCATGAGA CAATAACCCT GATAAATGCT TCAATAATAT TGAAAAACGC
1741 GCGAATTGCA AGCTCTGCAT TAATGAATCG GCCAACGCGC GGGGAGAGGC GGTTTGCGTA
1801 TTGGGCGCTC TTCCGCTTCC TCGCTCACTG ACTCGCTGCG CTCGGTCGTT CGGCTGCGGC
1861 GAGCGGTATC AGCTCACTCA AAGGCGGTAA TACGGTTATC CACAGAATCA GGGGATAACG
1921 CAGGAAAGAA CATGTGAGCA AAAGGCCAGC AAAAGGCCAG GAACCGTAAA AAGGCCGCGT
1981 TGCTGGCGTT TTTCCATAGG CTCCGCCCCC CTGACGAGCA TCACAAAAAT CGACGCTCAA
2041 GTCAGAGGTG GCGAAACCCG ACAGGACTAT AAAGATACCA GCGGTTTCCC CTATGGAAGCT
2101 CCCTCGTGCG CTCTCCTGTT CCGACCTTGC CGCTTACCGG ATACCTGTCC GCCTTTCTCC
2161 CTTCGGGAAG CGTGGCGCTT TCTCAATGCT CACGCTGTAG GTATCTCAGT TCGGTGTAGG
2221 TCGTTCGCTC CAAGCTGGGC TGTGTGCACG AACCCCCCGT TCAGCCCCGAC CGCTGCGCCT
2281 TATCCGGTAA CTATCGTCTT GAGTCCAACC CGGTAAGACA CGACTTATCG CCACTGGCAG
2341 CAGCCACTGG TAACAGGATT AGCAGAGCGA GGTATGTAGG CGGTGCTACA GAGTTCCTGA
2401 AGTGGTGGCC TAACTACGGC TACACTAGAA GGACAGTATT TGGTATCTGC GCTCTGCTGA
2461 AGCCAGTTAC CTTCCGAAAA AGAGTTGGTA GCTCTTGATC CGGCAACAAA ACCACCGCTG
2521 GTAGCGGTGG TTTTTTGTG TGCAAGCAGC AGATTACGCG CAGAAAAAAA GGATCTCAAG
2581 AAGATCCTTT GATCTTTTCT ACGGGGTCTG ACGCTCAGTG GAACGAAAAC TCACGTTAAG
2641 GGATTTTGGT CATGCCATAA CTTCGTATAT CATACATTAT ACGAAGTTAT GGCATGAGAT
2701 TATCAAAAAG GATCTTCACC TAGATCCTTT TAAATTAAAA ATGAAGTTT AAATCAATCT
2761 AAAGTATATA TGAGTAAACT TGGTCTGACA GTTACCAATG CTTAATCAGT GAGGCACCTA
2821 TCTCAGCGAT CTGTCTATTT CGTTCATCCA TAGTTGCCTG ACTCCCCGTC GTGTAGATAA
2881 CTACGATACG GGAGGGCTTA CCATCTGGCC CCAGTGCTGC AATGATACCG CGAGACCCAC
2941 GCTCACCAGC TCCAGATTTA TCAGCAATAA ACCAGCCAGC CGGAAGGGCC GAGCGCAGAA
3001 GTGGTCCTGC AACTTTATCC GCCTCCATCC AGTCTATTAA TTGTTGCCGG GAAGCTAGAG
3061 TAAGTAGTTC GCCAGTTAAT AGTTTGCGCA ACGTTGTTGC CATTGCTACA GGCATCGTGG
3121 TGTCACGCTC GTCGTTTGGT ATGGCTTCAT TCAGCTCCGG TTCCAACGA TCAAGGCGAG-
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3181 TTACATGATC CCCCATGTTG TGCAAAAAAG CGGTTAGCTC CTTCCGGTCCT CCGATCGTTG
3241 TCAGAAGTAA GTTGGCCGCA GTGTTATCAC TCATGGTTAT GGCAGCACTG CATAATTCTC
3301 TTA CTGTCAT GCCATCCGTA AGATGCTTTT CTGTGACTGG TGAGTACTCA ACCAAGTCAT
3361 TCTGAGAATA GTGTATGCGG CGACCGAGTT GCTCTTGCCC GGCCTCAATA CGGGATAATA
3421 CCGCGCCACA TAGCAGAACT TTAAAAGTGC TCATCATTGG AAAACGTTCT TCGGGGCGAA
3481 AACTCTCAAG GATCTTACCG CTGTTGAGAT CCAGTTCGAT GTAACCCACT CGTGCACCCA
3541 ACTGATCTTC AGCATCTTTT ACTTTCACCA GCGTTTCTGG GTGAGCAAAA ACAGGAAGGC
3601 AAAATGCCGC AAAAAAGGGA ATAAGGGCGA CACGGAAATG TTGAATACTC ATACTCTTCC
3661 TTTTTCATAA TTATTGAAGC ATTTATCAGG GTTATTGTCT CATGCCAGGG GTGGGCACAC
3721 ATATTTGATA CCAGCGATCC CTACACAGCA CATAATTCAA TGCGACTTCC CTCTATCGCA
3781 CATCTTAGAC CTTTATTCTC CCTCCAGCAC ACATCGAAGC TGCCGAGCAA GCCGTTCTCA
3841 CCAGTCCAAG ACCTGGCATG AGCGGATACA TATTTGAATG TATTTAGAAA AATAACAAA
3901 TAGGGGTTCC GCGCACATTT CCCCAGAAAAG TGCCACCTGA AATTGTAAAC GTTAATATTT
3961 TGTTAAAATT CGCGTTAAAT TTTTGTTAAA TCAGCTCATT TTTTAACCAA TAGGCCGAAA
4021 TCGGCAAAAT CCCTTATAAA TCAAAAGAAT AGACCGAGAT AGGGTTGAGT GTTGTTCAG
4081 TTTGGAACAA GAGTCCACTA TTAAAGAACG TGGACTCCAA CGTCAAAGGG CGAAAAACCG
4141 TCTATCAGGG CGATGGCCCA CTACGTGAAC CATCACCCCTA ATCAAGTTTT TTGGGGTCTGA
4201 GGTGCCGTAA AGCACTAAAT CGGAACCCTA AAGGGAGCCC CCGATTAGA GCTTGACGGG
4261 GAAAGCCGGC GAACGTGGCG AGAAAGGAAG GGAAGAAAGC GAAAGGAGCG GCGCTAGGG
4321 CGCTGGCAAG TGTAGCGGTC ACGCTGCGCG TAACCACCAC ACCCGCCGCG CTTAATGCGC
4381 CGCTACAGGG CGCGTC

FIGURE 48D



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pDONR201 4470 bp (rotated to position 3516)

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
260..29	attP1
656..961	ccdB
1099..1184	ccdA
1303..1962	CmR
2210..2442	attP2
2565..3374	Kmr
3495..4134	ori

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1 GTTAACGCTA GCATGGATCT CGGGCCCCAA ATAATGATTT TATTTTGACT GATAGTGACC
61 TGTTTCGTTGC AACAAATTGA TGAGCAATGC TTTTTTATAA TGCCAACTTT GTACAAAAAA
121 GCTGAACGAG AAACGTAAAA TGATATAAAT ATCAATATAT TAAATTAGAT TTTGCATAAA
181 AAACAGACTA CATAACTCTG TAAACACAA CATATCCAGT CACTATGAAT CAACTACTTA
241 GATGGTATTA GTGACCTGTA GTCGACCGAC AGCCTTCCAA ATGTTCTTCG GGTGATGCTG
301 CCAACTTAGT CGACCGACAG CCTTCCAAAT GTTCTTCTCA AACGGAATCG TCGTATCCAG
361 CCTACTCGCT ATTGTCCTCA ATGCCGTATT AAATCATAAA AAGAAATAAG AAAAAGAGGT
421 GCGAGCCTCT TTTTGTGTG ACAAAATAAA AACATCTACC TATTCATATA CGCTAGTGTC
481 ATAGTCCTGA AAATCATCTG CATCAAGAAC AATTTACAA CTCTTATACT TTTCTCTTAC
541 AAGTCGTTTC GCTTCATCTG GATTTTCAGC CTCTATACTT ACTAAACGTG ATAAAGTTTC
601 TGTAATTTCT ACTGTATCGA CCTGCAGACT GGCTGTGTAT AAGGGAGCCT GACATTTATA
661 TTCCCCAGAA CATCAGGTTA ATGGCGTTTT TGATGTCATT TTCGCGGTGG CTGAGATCAG
721 CCACTTCTTC CCCGATAACG GAGACCGGCA CACTGGCCAT ATCGGTGGTC ATCATGCGCC
781 AGCTTTCATC CCCGATATGC ACCACCGGGT AAAGTTACAG GGAGACTTTA TCTGACAGCA
841 GACGTGCACT GGCCAGGGGG ATCACCATCC GTCGCCCCGG CGTGTCATAA ATATCACTCT
901 GTACATCCAC AAACAGACGA TAACGGCTCT CTCTTTTATA GGTGTAAACC TTAACTGCA
961 TTTCAACCAT CCCTGTTCTC GTCAGCAAAA GAGCCGTTCA TTTCAATAAA CCGGGCGACC
1021 TCAGCCATCC CTTCCTGATT TTCCGCTTTC CAGCGTTCGG CACGCAGACG ACGGGCTTCA
1081 TTCTGCAATG TTGTGCTTAC CAGACCGGAG ATATTGACAT CATATATGCC TTGAGCAACT
1141 GATAGCTGTC GCTGTCAACT GTCAGTGTA TACGCTGCTT CATAGCACAC CTCTTTTGA
1201 CATACTTCGG GTATACATAT CAGTATATAT TCTTATACCG CAAAATCAG CGCGCAAATA
1261 CGCATACTGT TATCTGGCTT TTAGTAAGCC GGATCCACGC GATTACGCCC CGCCCTGCCA
1321 CTCATCGCAG TACTGTTGTA ATTCATTAAG CATTCTGCCG ACATGGAAGC CATCACAGAC
1381 GGCATGATGA ACCTGAATCG CCAGCGGCAT CAGCACCTTG TCGCCTTGCG TATAATATT
1441 GCCCATGGTG AAAACGGGGG CGAAGAAGTT GTCCATATTG GCCACGTTTA AATCAAACT
1501 GGTGAAACTC ACCCAGGGAT TGGCTGAGAC GAAAAACATA TTCTCAATAA ACCCTTTAGG
1561 GAAATAGGCC AGGTTTTCAC CGTAACACGC CACATCTTGC GAATATATGT GTAGAACTG
1621 CCGGAAATCG TCGTGATATT CACTCCAGAG CGATGAAAAC GTTTCAGTTT GCTCATGGAA
1681 AACGGTGTA CAAGGGTGAA CACTATCCCA TATCACCAGC TCACCGTCTT TCATTGCCAT
1741 ACGGAATTCC GGATGAGCAT TCATCAGGCG GGCAAGAATG TGAATAAAGG CCGGATAAAA
1801 CTTGTGCTTA TTTTCTTTA CGGTCTTTAA AAAGGCCGTA ATATCCAGCT GAACGGTCTG
1861 GTTATAGGTA CATTGAGCAA CTGACTGAAA TGCCTCAAAA TGTTCTTTAC GATGCCATTG
1921 GGATATATCA ACGGTGGTAT ATCCAGTGAT TTTTTTCTCC ATTTTAGCTT CCTTAGCTCC
1981 TGAAAATCTC GATAACTCAA AAAATACGCC CGGTAGTGAT CTTATTTTAT TATGGTGAAA
2041 GTTGGAACCT CTTACGTGCC GATCAACGTC TCATTTTCGC CAAAAGTTGG CCCAGGGCTT
2101 CCCGGTATCA ACAGGGACAC CAGGATTTAT TTATTCTGCG AAGTGATCTT CCGTCACAGG
2161 TATTTATTTC GCGCAAAGTG CGTCGGGTGA TGCTGCCAAC TTAGTCGACT ACAGGTCAC
2221 AATACCATCT AAGTAGTTGA TTCATAGTGA CTGGATATGT TGTGTTTAC AGTATTATGT
2281 AGTCTGTTTT TTATGCAAAA TCTAATTTAA TATATTGATA TTTATATCAT TTTATCGTTT
2341 TCGTTCAGCT TTCTGTGACA AAGTTGGCAT TATAAGAAAG CATTGCTTAT CAATTTGTTG
2401 CAACGAACAG GTCATATCA GTCAAAATAA AATCATTATT TGCCATCCAG CTGCAGCTCT
2461 GGCCCGTGTC TCAAAATCTC TGATGTTACA TTGCACAAGA TAAAAATATA TCATCATGAA
2521 CAATAAACT GTCTGCTTAC ATAAACAGTA ATACAAGGGG TGTTATGAGC CATATTCAAC
2581 GGGAAACGTC GAGGCCGCGA TTAAATPCCA ACATGGATGC TGATTTATAT GGGTATAAAT
2641 GGGCTCGCGA TAATGTCGGG CAATCAGGTG CGACAATCTA TCGCTTGATG GGGGAAGCCC
2701 ATGCGCCAGA GTTGTCTCTG AAACATGGCA AAGGTAGCGT TGCCAATGAT GTTACAGATG -

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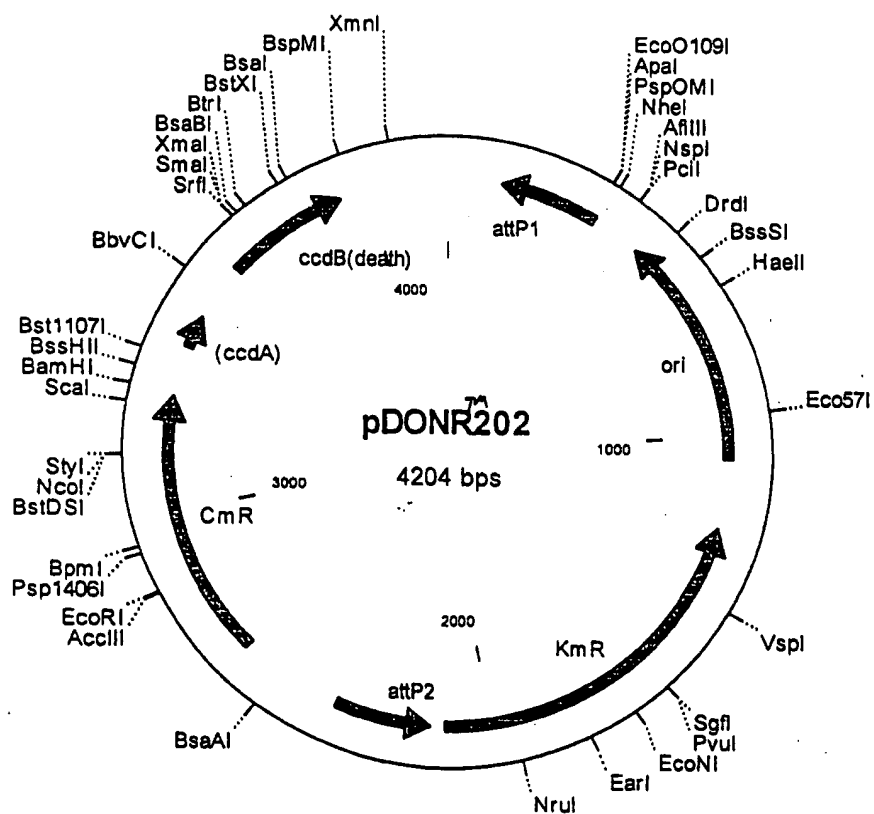
FIGURE 49B

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2761 AGATGGTCAG ACTAACTGG CTGACGGAAT TTATGCCTCT TCCGACCATC AAGCATTTTA
2821 TCCGTACTCC TGATGATGCA TGGTACTCA CCACTGCGAT CCCC GGAAAA ACAGCATTCC
2881 AGGTATTAGA AGAATATCCT GATTCAGGTG AAAATATTGT TGATGCGCTG GCAGTGTTCC
2941 TCGCGCGGTT GCATTGCGATT CCTGTTTGTA ATTGTCCTTT TAACAGCGAT CGCGTATTTC
3001 GTCTCGCTCA GCGCGCAATCA CGAATGAATA ACGGTTTGGT TGATGCGAGT GATTTTGATG
3061 ACGAGCGTAA TGGCTGGCCT GTTGAACAAG TCTGGAAAGA AATGCATAAA CTTTTGCCAT
3121 TCTCACCGGA TTCAGTCGTC ACTCATGGTG ATTTCTCACT TGATAACCTT ATTTTGTACG
3181 AGGGGAAATT AATAGGTTGT ATTGATGTTG GACGAGTCGG AATCGCAGAC CGATACCAGG
3241 ATCTTGCCAT CCTATGGAAC TGCCTCGGTG AGTTTTCTCC TTCATTACAG AAACGGCTTT
3301 TTCAAAAATA TGGTATTGAT AATCCTGATA TGAATAAATT GCAGTTTCAT TTGATGCTCG
3361 ATGAGTTTTT CTAATCAGAA TTGGTTAATT GGTTGTAACA CTGGCAGAGC ATTACGCTGA
3421 CTTGACGGGA CGGCGCAAGC TCATGACCAA AATCCCTTAA CGTGAGTTTT CGTTCCACTG
3481 AGCGTCAGAC CCCGTAGAAA AGATCAAAGG ATCTTCTTGA GATCCTTTTT TTCTGCGCGT
3541 AATCTGCTGC TTGCAAACAA AAAAACCACC GCTACCAGCG GTGGTTTGTG TGCCGGATCA
3601 AGAGCTACCA ACTCTTTTTC CGAAGGTAAC TGGCTTCAGC AGAGCGCAGA TACCAAATAC
3661 TGTCTTCTA GTGTAGCCGT AGTTAGGCCA CCACTTCAAG AACTCTGTAG CACCGCCTAC
3721 ATACCTCGCT CTGCTAATCC TGTTACCAGT GGCTGCTGCC AGTGGCGATA AGTCGTGTCT
3781 TACCGGGTTG GACTCAAGAC GATAGTTACC GGATAAGGCG CAGCGGTCGG GCTGAACGGG
3841 GGGTTCGTGC ACACAGCCCA GCTTGGAGCG AACGACCTAC ACCGAACTGA GATACCTACA
3901 GCGTGAGCTA TGAGAAAGCG CCACGCTTCC CGAAGGGAGA AAGGCGGACA GGTATCCGGT
3961 AAGCGGCAGG GTCGGAACAG GAGAGCGCAC GAGGGAGCTT CCAGGGGGAA ACGCCTGGTA
4021 TCTTTATAGT CCTGTGCGGT TTCGCCACCT CTGACTTGAG CGTCGATTTT TGTGATGCTC
4081 GTCAGGGGGG CGGAGCCTAT GGAAAAACGC CAGCAACGCG GCCTTTTTTAC GGTTCCTGGC
4141 CTTTTGCTGG CTTTTTGCTC ACATGTTCTT TCCTGCGTTA TCCCCTGATT CTGTGGATAA
4201 CCGTATTACC GCTAGCCAGG AAGAGTTTGT AGAAACGCAA AAAGGCCATC CGTCAGGATG
4261 GCCTTCTGCT TAGTTTGATG CCTGGCAGTT TATGGCGGGC GTCCTGCCCG CCACCCTCCG
4321 GGCCGTTGCT TCACAACGTT CAAATCCGCT CCCGGCGGAT TTGTCCTACT CAGGAGAGCG
4381 TTCACCGACA AACACAGAT AAAACGAAAG GCCCAGTCTT CCGACTGAGC CTTTCGTTTT
4441 ATTTGATGCC TGGCAGTTCC CTACTCTCGC

FIGURE 49C

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FIGURE 50A: pDONR202 (kan^R)



pDONR202 4204 bp

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
369..127	attP1
486..1059	ori
1228..2107	KmR
2381..2140	attP2
2629..3288	CmR
3408..3492	inactivated ccdA
3630..3935	ccdB

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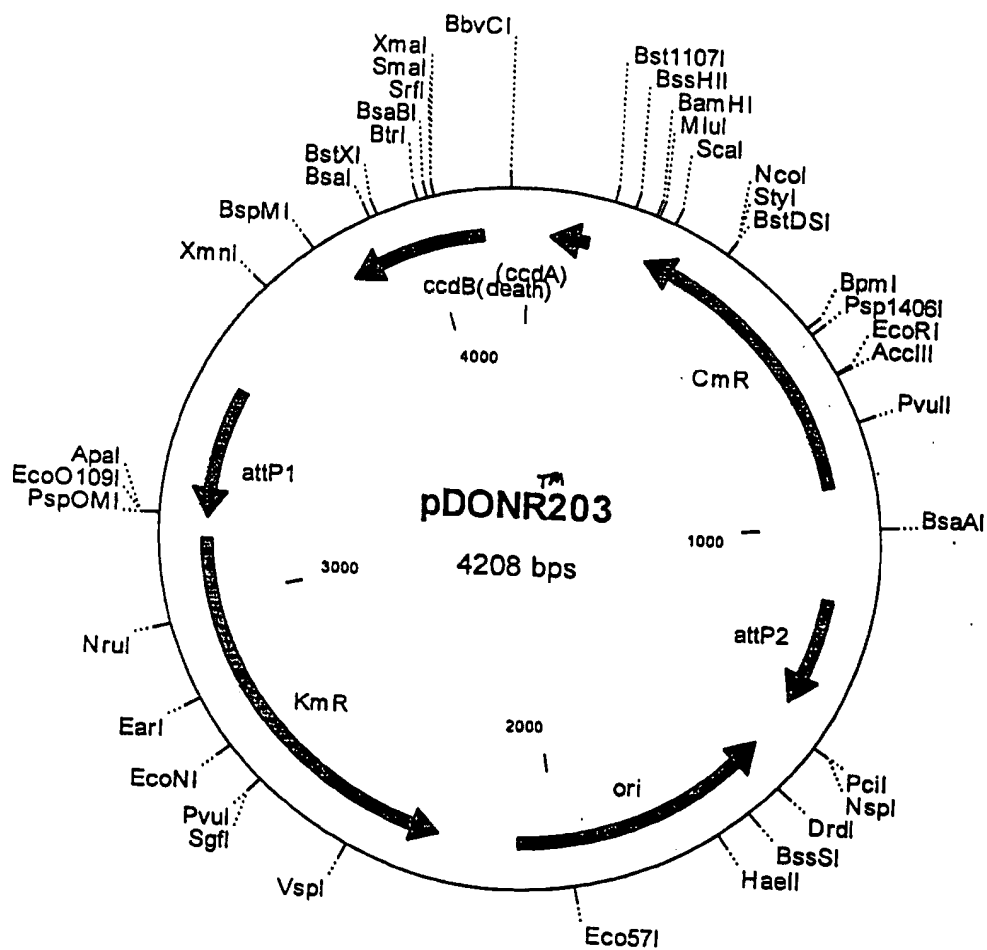
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61 GGAAGGCTGT CGGTCGACTA AGTTGGCAGC ATCACCCGAA GAACATTTGG AAGGCTGTCTG
121 GTCGACTACA GGTCACTAAT ACCATCTAAG TAGTTGATTC ATAGTGACTG GATATGTTGT
181 GTTTTACAGT ATTATGTAGT CTGTTTTTTA TGCAAAATCT AATTTAATAT ATTGATATTT
241 ATATCATTTT ACGTTTCTCG TTCAGCTTTT TTGTACAAAG TTGGCATTAT AAAAAAGCAT
301 TGCTCATCAA TTTGTTGCAA CGAACAGGTC ACTATCAGTC AAAATAAAAT CATTATTTGG
361 GGCCCGAGAT CCATGCTAGC GGTAAACGG TTATCCACAG AATCAGGGGA TAACGCAGGA
421 AAGAACATGT GAGCAAAAGG CCAGCAAAAG GCCAGGAACC GTAAAAAGGC CGCGTTGCTG
481 GCGTTTTTCC ATAGGCTCCG CCCCCCTGAC GAGCATCACA AAAATCGACG CTCAAGTCAG
541 AGGTGGCGAA ACCCGACAGG ACTATAAAGA TACCAGGCGT TCCCCCTGG AAGCTCCCTC
601 GTGCGCTCTC CTGTTCCGAC CCTGCGCTT ACCGGATACC TGTCCGCTT TCTCCCTTCG
661 GGAAGCGTGG CGCTTTCTCA TAGCTCACGC TGTAGGTATC TCAGTTCGGT GTAGGTCGTT
721 CGCTCCAAGC TGGGCTGTGT GCACGAACCC CCCGTTGAGC CCGACCGCTG CGCCTTATCC
781 GGTAACATATC GTCTTGAGTC CAACCCGGTA AGACACGACT TATCGCCACT GGCAGCAGCC
841 ACTGGTAACA GGATTAGCAG AGCGAGGTAT GTAGGCGGTG CTACAGAGTT CTTGAAGTGG
901 TGGCCTAACT ACGGCTACAC TAGAAGGACA GTATTTGGTA TCTGCGCTCT GCTGAAGCCA
961 GTTACCTTCG GAAAAAGAGT TGGTAGCTCT TGATCCGGCA AACAAACCAC CGCTGGTAGC
1021 GGTGGTTTTT TTGTTTGCAA GCAGCAGAT ACGCGCAGAA AAAAAGGATC TCAAGAAGAT
1081 CCTTTGATCT TTTCTACGGG GTCTGACGTT CAGTGGAACG AAAACTCAGG TTAAGGGATT
1141 TTGGTCATGA GCTTGCGCCG TCCCGTCAAG TCAGCGTAAT GCTCTGCCAG TGTTACAACC
1201 AATTAACCAA TTCTGATTAG AAAAATCAT CGAGCATCAA ATGAAACTGC AATTTATTCA
1261 TATCAGGATT ATCAATACCA TATTTTTGAA AAAGCCGTTT CTGTAATGAA GGAGAAAAC
1321 CACCGAGGCA GTTCCATAGG ATGGCAAGAT CCTGGTATCG GTCTGCGATT CCGACTCGTC
1381 CAACATCAAT ACAACCTATT AATTTCCCCT CGTCAAAAAT AAGGTTATCA AGTGAGAAAT
1441 CACCATGAGT GACGACTGAA TCCGGTGAGA ATGGCAAAAG TTTATGCATT TCTTTCCAGA
1501 CTTGTTCAAC AGGCCAGCCA TTACGCTCGT CATCAAAATC ACTCGCATCA ACCAAACCGT
1561 TATTCATTCG TGATTGCGCC TGAGCGAGAC GAAATACGCG ATCGCTGTTA AAAGGACAAT
1621 TACAAACAGG AATCGAATGC AACCGGCGCA GGAACACTGC CAGCGCATCA ACAATATTTT
1681 CACCTGAATC AGGATATTCT TCTAATACCT GGAATGCTGT TTTTCCGGGG ATCGCAGTGG
1741 TGAGTAACCA TGCATCATCA GGAGTACGGA TAAATGCTT GATGGTCGGA AGAGGCATAA
1801 ATTCCGTCAG CCAGTTTAGT CTGACCATCT CATCTGTAAC ATCATTGGCA ACGCTAACCTT
1861 TGCCATGTTT CAGAAACAAC TCTGGCGCAT CGGGCTTCCC ATACAAGCGA TAGATTGTCG
1921 CACCTGATTG CCCGACATTA TCGCGAGCCC ATTTATACCC ATATAAATCA GCATCCATGT
1981 TGGAAATTAA TCGCGGCCCT GACGTTTCCC GTTGAATATG GCTCATAACA CCCCTTGTAT
2041 TACTGTTTAT GTAAGCAGAC AGTTTTATTG TTCATGATGA TATATTTTTA TCTGTGCAA
2101 TGTAACATCA GAGATTTTGA GACACGGGCC AGAGCTGCAG CTGGATGGCA AATAATGATT
2161 TTATTTTGAC TGATAGTGAC CTGTTCTGTT CAACAAATTG ATAAGCAATG CTTTCTTATA
2221 ATGCCAATT TGTACAAGAA AGCTGAACGA GAAACGTAAA ATGATATAAA TATCAATATA
2281 TTAAATTAGA TTTTGCTATA AAAACAGACT ACATAATACT GTAAAACACA ACATATCCAG
2341 TCACTATGAA TCAACTACT AGATGGTATT AGTGACCTGT AGTCGACTAA GTTGGCAGCA
2401 TCACCCGACG CACTTTGCGC CGAATAAATA CCTGTGACGG AAGATCACTT CGCAGAATAA
2461 ATAAATCCTG GTGTCCCTGT TGATACCGGG AAGCCCTGGG CCAACTTTTG GCGAAAATGA
2521 GACGTTGATC GGCACGTAAG AGGTTCCAAC TTTCACCATA ATGAAATAAG ATCACTACCG
2581 GGCCTATTTT TTGAGTTATC GAGATTTTCA GGAGCTAAGG AAGCTAAAAT GGAGAAAAAA
2641 ATCACTGGAT ATACCACCGT TGATATATCC CAATGGCATC GTAAAGAACA TTTTGAGGCA
2701 TTTCACTCAG TTGCTCAATG TACCTATAAC CAGACCGTTC AGCTGGATAT TACGGCCTTT -

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2761 TTAAAGACCG TAAAGAAAA TAAGCACAAG TTTTATCCGG CCTTTATTCA CATTCTTGCC
2821 CGCCTGATGA ATGCTCATCC GGAATTCCGT ATGGCAATGA AAGACGGTGA GCTGGTGATA
2881 TGGGATAGTG TTCACCCTTG TTACACCGTT TTCCATGAGC AAACGAAAC GTTTTCATCG
2941 CTCTGGAGTG AATACCACGA CGATTTCCGG CAGTTTCTAC ACATATATTC GCAAGATGTG
3001 GCGTGTTACG GTGAAAACCT GGCCTATTTT CCTAAAGGGT TTATTGAGAA TATGTTTTTC
3061 GTCTCAGCCA ATCCCTGGGT GAGTTTCACC AGTTTGTATT TAAACGTGGC CAATATGGAC
3121 AACTTCTTCG CCCCCGTTTT CACCATGGGC AAATATTATA CGCAAGGCGA CAAGGTGCTG
3181 ATGCCGCTGG CGATTCAGGT TCATCATGCC GTCTGTGATG GCTTCCATGT CGGCAGAATG
3241 CTTAATGAAT TACAACAGTA CTGCGATGAG TGGCAGGGCG GGGCGTAATC GCGTGGATCC
3301 GGCTTACTAA AAGCCAGATA ACAGTATGCG TATTGCGCG CTGATTTTGT CCGTATAAGA
3361 ATATATACTG ATATGTATAC CCGAAGTATG TCAAAAAGAG GTGTGCTATG AAGCAGCGTA
3421 TTACAGTGAC AGTTGACAGC GACAGCTATC AGTTGCTCAA GGCATATATG ATGTCAATAT
3481 CTCCGGTCTG GTAAGCACAA CCATGCAGAA TGAAGCCCGT CGTCTGCGTG CCGAACGCTG
3541 GAAAGCGGAA AATCAGGAAG GGATGGCTGA GGTCGCCCCG TTTATTGAAA TGAACGGCTC
3601 TTTTGCTGAC GAGAACAGGG ACTGGTGAAG TGCAGTTTAA GGTTTACACC TATAAAGAG
3661 AGAGCCGTTA TCGTCTGTTT GTGGATGTAC AGAGTGATAT TATTGACACG CCCGGGCGAC
3721 GGATGGTGAT CCCCCTGGCC AGTGCACGTC TGCTGTCAGA TAAAGTCTCC CGTGAACTTT
3781 ACCCGGTGGT GCATATCGGG GATGAAAGCT GGCGCATGAT GACCACCGAT ATGGCCAGTG
3841 TGCCGGTCTC CGTTATCGGG GAAGAAGTGG CTGATCTCAG CCACCGCGAA AATGACATCA
3901 AAAACGCCAT TAACCTGATG TTCTGGGGAA TATAAATGTC AGGCTCCCTT ATACACAGCC
3961 AGTCTGCAGG TCGATACAGT AGAAATTACA GAAACTTTAT CACGTTTAGT AAGTATAGAG
4021 GCTGAAAATC CAGATGAAGC CGAACGACTT GTAAGAGAAA AGTATAAGAG TTGTGAAATT
4081 GTTCTTGATG CAGATGATTT TCAGGACTAT GACACTAGCG TATATGAATA GGTAGATGTT
4141 TTTATTTTGT CACACAAAA AGAGGCTCGC ACCTCTTTTT CTTATTTCTT TTTATGATTT
4201 AATA

FIGURE 50C

FIGURE 51A pDONR203 (kan^R)

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pDONR203 4208 bp

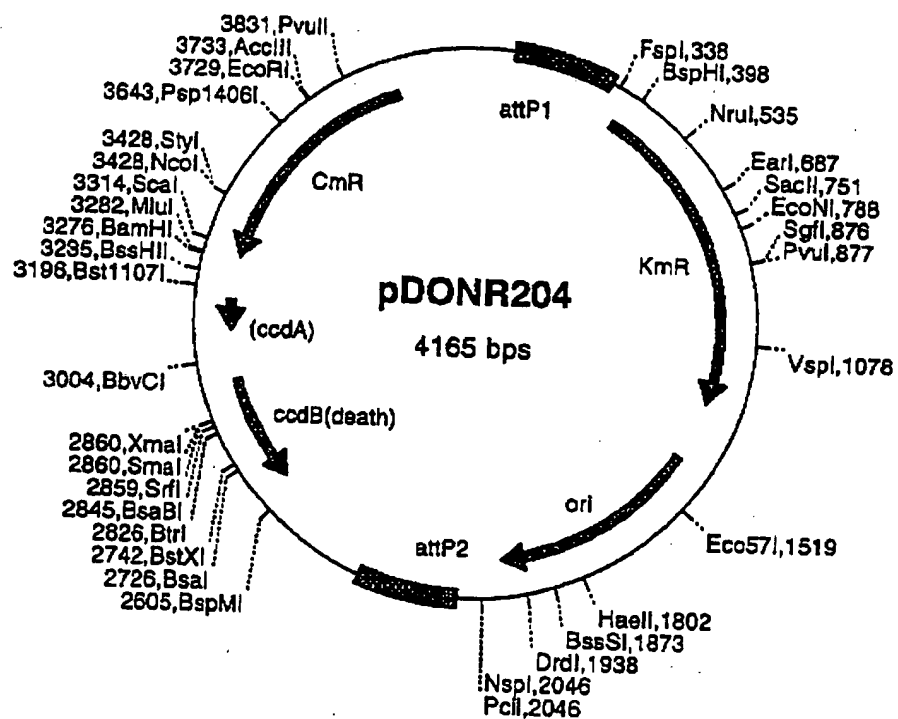
<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
47..131		inactivated ccdA
251..910		CmR
1158..1398		attP2
1509..2082		ori
2251..3130		KmR
3464..3174		attP1
3812..4117		ccdB

1	GCCTTCGGCA	CGCAGACGAC	GGGCTTCATT	CTGCATGGTT	GTGCTTACCA	GACCGGAGAT
61	ATTGACATCA	TATATGCCTT	GAGCAACTGA	TAGCTGTCGC	TGTCAACTGT	CACTGTAATA
121	CGCTGCTTCA	TAGCACACCT	CTTTTGTACA	TACTTCGGGT	ATACATATCA	GTATATATTC
181	TTATACCGCA	AAAATCAGCG	CGCAAATACG	CATACTGTTA	TCTGGCTTTT	AGTAAGCCGG
241	ATCCACGCGT	TTACGCCCCG	CCCTGCCACT	CATCGCAGTA	CTGTTGTAAT	TCATTAAGCA
301	TTCTGCCGAC	ATGGAAGCCA	TCACAGACGG	CATGATGAAC	CTGAATCGCC	AGCGGCATCA
361	GCACCTTGTC	GCCTTGCGTA	TAATATTTGC	CCATGGTGAA	AACGGGGGCG	AAGAAGTTGT
421	CCATATTGGC	CACGTTTAAA	TCAAACTGG	TGAACTCAC	CCAGGGATTG	GCTGAGACGA
481	AAAACATATT	CTCAATAAAC	CCTTTAGGGA	AATAGGCCAG	GTTTTACCG	TAACACGCCA
541	CATCTTGCGA	ATATATGTGT	AGAACTGCC	GGAAATCGTC	GTGGTATTCA	CTCCAGAGCG
601	ATGAAAACGT	TTCAGTTTGC	TCATGGAAAA	CGGTGTAACA	AGGGTGAACA	CTATCCCAT
661	TCACCAGCTC	ACCGTCTTTC	ATTGCCATAC	GGAATTCGG	ATGAGCATT	ATCAGGCGGG
721	CAAGAATGTG	AATAAAGGCC	GGATAAACT	TGTGCTTATT	TTTCTTTACG	GTCTTTAAAA
781	AGGCCGTAAT	ATCCAGCTGA	ACGGTCTGGT	TATAGGTACA	TTGAGCAACT	GACTGAAATG
841	CCTCAAAATG	TTCTTTACGA	TGCCATTGGG	ATATATCAAC	GGTGGTATAT	CCAGTGATTT
901	TTTTCTCCAT	TTTAGCTTCC	TTAGCTCCTG	AAAATCTCGA	TAACTCAAAA	AATACGCCCG
961	GTAGTGATCT	TATTTTCATTA	TGGTGAAAGT	TGGAACCTCT	TACGTGCCGA	TCAACGTCTC
1021	ATTTTCGCCA	AAAGTTGGCC	CAGGGCTTCC	CGGTATCAAC	AGGGACACCA	GGATTTATTT
1081	ATTCTGCGAA	GTGATCTTCC	GTACACAGTA	TTTATTCGGC	GCAAAGTGCG	TCGGGTGATG
1141	CTGCCAACTT	AGTCGACTAC	AGGTCACATA	TACCATCTAA	GTAGTTGATT	CATAGTGACT
1201	GGATATGTTG	TGTTTTACAG	TATTATGTAG	TCTGTTTTTT	ATGCAAAATC	TAATTTAATA
1261	TATTGATATT	TATATCATTT	TACGTTTCTC	GTTTCAGCTT	CTTGACAAA	GTTGGCATT
1321	TAAGAAAGCA	TTGCTTATCA	ATTTGTTGCA	ACGAACAGGT	CACTATCAGT	CAAAATAAAA
1381	TCATTATTTG	CCATCCAGCT	AGCGGTAATA	CGGTTATCCA	CAGAATCAGG	GGATAACGCA
1441	GGAAAGAACA	TGTGAGCAAA	AGGCCAGCAA	AAGGCCAGGA	ACCGTAAAAA	GGCCGCGTTG
1501	CTGGCGTTTT	TCCATAGGCT	CCGCCCCCCT	GACGAGCATC	ACAAAAATCG	ACGCTCAAGT
1561	CAGAGGTGGC	GAAACCCGAC	AGGACTATAA	AGATACCAGG	CGTTTCCCCC	TGGAAGCTCC
1621	CTCGTGCGCT	CTCCTGTTCC	GACCTTGCCG	CTTACCGGAT	ACCTGTCCGC	CTTCTCCCT
1681	TCGGGAAGCG	TGGCGCTTTC	TCATAGCTCA	CGCTGTAGGT	ATCTCAGTTC	GGTGTAGGTC
1741	GTTGCTCCA	AGCTGGGCTG	TGTGCACGAA	CCCCCGTTT	AGCCCGACCG	CTGCGCTTA
1801	TCCGGTAACT	ATCGTCTTGA	GTCCAACCCG	GTAAGACACG	ACTTATCGCC	ACTGGCAGCA
1861	GCCACTGGTA	ACAGGATTAG	CAGAGCGAGG	TATGTAGGCG	GTGCTACAGA	GTTCTTGAAG
1921	TGGTGGCCTA	ACTACGGCTA	CACTAGAAGA	ACAGTATTTG	GTATCTGCGC	TCTGCTGAAG
1981	CCAGTTACCT	TCGGAAAAAG	AGTTGGTAGC	TCTTGATCCG	GCAAAACAA	CACCGCTGGT
2041	AGCGGTGGTT	TTTTTGTGTT	CAAGCAGCAG	ATTACGCGCA	GAAAAAAGG	ATCTCAAGAA
2101	GATCCTTTGA	TCTTTTCTAC	GGGGTCTGAC	GCTCAGTGGA	ACGAAAACTC	ACGTTAAGGG
2161	ATTTTGGTCA	TGAGCTTGCG	CCGTCCCGTC	AAGTCAGCGT	AATGCTCTGC	CAGTGTTACA
2221	ACCAATTAAC	CAATTCTGAT	TAGAAAACT	CATCGAGCAT	CAAATGAAAC	TGCAATTTAT
2281	TCATATCAGG	ATTATCAATA	CCATATTTTT	GAAAAAGCCG	TTTCTGTAAT	GAAGGAGAAA
2341	ACTCACCGAG	GCAGTTCCAT	AGGATGGCAA	GATCCTGGTA	TCGGTCTGCG	ATTCCGACTC
2401	GTCCAACATC	AATAACAACCT	ATTAATTTCC	CCTCGTCAAA	AATAAGGTTA	TCAAGTGAGA
2461	AATCACCATG	AGTGACGACT	GAATCCGGTG	AGAATGGCAA	AAGTTTATGC	ATTCTTTTCC
2521	AGACTTGTTT	AACAGGCCAG	CCATTACGCT	CGTCATCAAA	ATCACTCGCA	TCAACCAAAC
2581	CGTTATTTCAT	TCGTGATTGC	GCCTGAGCGA	GACGAAATAC	GCGATCGCTG	TTAAAAGGAC
2641	AATTACAAAC	AGGAATCGAA	TGCAACCGGC	GCAGGAACAC	TGCCAGCGCA	TCAACAATAT
2701	TTTCACCTGA	ATCAGGATAT	TCTTCTAATA	CCTGGAATGC	TGTTTTTCCG	GGGATCCGAG-

FIGURE 51B

2761 TGGTGAGTAA CCATGCATCA TCAGGAGTAC GGATAAAATG CTTGATGGTC GGAAGAGGCA
2821 TAAATTCGGT CAGCCAGTTT AGTCTGACCA TCTCATCTGT AACATCATTG GCAACGCTAC
2881 CTTTGCCATG TTTCAGAAAC AACTCTGGCG CATCGGGCTT CCCATACAAG CGATAGATTG
2941 TCGCACCTGA TTGCCCCGACA TTATCGCGAG CCCATTTATA CCCATATAAA TCAGCATCCA
3001 TGTGGAATT TAATCGCGGC CTCGACGTTT CCCGTTGAAT ATGGCTCATA ACACCCCTTG
3061 TATTACTGTT TATGTAAGCA GACAGTTTTA TTGTTTCATGA TGATATATTT TTATCTTGTTG
3121 CAATGTAACA TCAGAGATTT TGAGACACGG GCCAGAGCTG CAGCTAGCAT GGATCTCGGG
3181 CCCCAAATAA TGATTTTATT TTGACTGATA GTGACCTGTT CGTTGCAACA AATTGATGAG
3241 CAATGCTTTT TTATAATGCC AACTTTGTAC AAAAAAGCTG AACGAGAAAC GTAAAATGAT
3301 ATAAATATCA ATATATTAAA TTAGATTTTG CATAAAAAAC AGACTACATA ATACTGTAAA
3361 ACACAACATA TCCAGTCACT ATGAATCAAC TACTTAGATG GTATTAGTGA CCTGTAGTCG
3421 ACCGACAGCC TTCCAAATGT TCTTCGGGTG ATGCTGCCAA CTTAGTCGAC CGACAGCCTT
3481 CCAAATGTTT TTCTCAAACG GAATCGTCGT ATCCAGCCTA CTCGCTATTG TCCTCAATGC
3541 CGTATTAAAT CATAAAAAGA AATAAGAAAA AGAGGTGCGA GCCTCTTTTT TGTGTGACAA
3601 AATAAAAACA TCTACCTATT CATATACGCT AGTGTCATAG TCCTGAAAAAT CATCTGCATC
3661 AAGAACAATT TCACAACCTT TATACTTTTC TCTTACAAGT CGTTCGGCTT CATCTGGATT
3721 TTCAGCCTCT ATACTTACTA AACGTGATAA AGTTTCTGTA ATTTCTACTG TATCGACCTG
3781 CAGACTGGCT GTGTATAAGG GAGCCTGACA TTTATATTCC CCAGAACATC AGGTAAATGG
3841 CGTTTTTGAT GTCATTTTCG CGGTGGCTGA GATCAGCCAC TTCTTCCCCG ATAACGGAGA
3901 CCGGCACACT GGCCATATCG GTGGTCATCA TGCGCCAGCT TTCATCCCCG ATATGCACCA
3961 CCGGGTAAAG TTCACGGGAG ACTTTATCTG ACAGCAGACG TGCACTGGCC AGGGGGATCA
4021 CCATCCGTCG CCCGGGCGTG TCAATAATAT CACTCTGTAC ATCCACAAAC AGACGATAAC
4081 GGCTCTCTCT TTTATAGGTG TAAACCTTAA ACTGCATTTT ACCAGTCCCT GTTCTCGTCA
4141 GCAAAAGAGC CGTTCATTTT AATAAACCGG GCGACCTCAG CCATCCCTTC CTGATTTTCC
4201 GCTTTCCA

FIGURE 51C

FIGURE 52A pDONR204 (kan^R)

pDONR204 4165 bp

1 CGGCATTGAG GACAATAGCG AGTAGGCTGG ATACGACGAT TCCGTTTGAG AAGAACATTT
61 GGAAGGCTGT CCGTCGACTA CAGGTCACCTA ATACCATCTA AGTAGTTGAA TCATAGTGAC
121 TGGATATGTT GTGTTTTACA GTATTATGTA GTCTGTTTTT TATGCAAAAT CTAATTTAAT
181 ATATTGATAT TTATATCATT TTACGTTTCT CGTTCAGCTT TTTTGTACAA AGTTGGCATT
241 ATAAAAAGC ATTGCTTATC AATTGTGTGC AACGAACAGG TCACTATCAG TCAAAATAAA
301 ATCATTATTT GGGGCCCCGAG ATCCATGCTA GCTGCAGTGC GCAGGGCCCCG TGTCTCAAAA
361 TCTCTGATGT TACATTGCAC AAGATAAAAA TATATCATCA TGAACAATAA AACTGTCTGC
421 TTACATAAAC AGTAATACAA GGGGTGTTAT GAGCCATATT CAACGGGAAA CGTCTTGCTG
481 GAGGCCGCGA TTAAATTCCA ACATGGATGC TGATTTATAT GGGTATAAAT GGGCTCGCGA
541 TAATGTCGGG CAATCAGGTG CGACAATCTT TCGATTGTAT GGAAGCCCCG ATGCGCCAGA
601 GTTGTTCCTG AAACATGGCA AAGGTAGCGT TGCCAATGAT GTTACAGATG AGATGGTCAG
661 ACTAACTGG CTGACGGAAT TTATGCCTCT TCCGACCATC AAGCATTTTA TCCGTACTCC
721 TGATGATGCA TGGTTACTCA CCACTGCGAT CCGCGGGAAA ACAGCATTCC AGGTATTAGA
781 AGAATATCCT GATTCAAGTG AAAATATTGT TGATGCGCTG GCAGTGTTCC TGCGCCGGTT
841 GCATTGCGATT CCTGTTTGTA ATTGTCCTTT TAACAGCGAT CGCGTATTTC GTCTCGCTCA
901 GGCCTCAATT CGAATGAATA ACGGTTTGGT TGATGCGAGT GATTTTGATG ACGAGCGTAA
961 TGGCTGGCCT GTTGAACAAG TCTGGAAAGA AATGCATACG CTTTGGCCAT TCTCACCGGA
1021 TTCAGTCGTC ACTCATGGTG ATTTCTCACT TGATAACCTT ATTTTGTACG AGGGGAAATT
1081 AATAGGTTGT ATTGATGTTG GACGAGTCGG AATCGCAGAC CGATACCAGG ATCTTGCCAT
1141 CCTATGGAAC TGCCTCGGTG AGTTTTCTCC TTCATTACAG AAACGGCTTT TTCAAAAATA
1201 TGGTATTGAT AATCCTGATA TGAATAAATT GCAGTTTCAT TTGATGCTCG ATGAGTTTTT
1261 CTAATCAGAA TTGGTTAATT GGTTGTAACA CTGGCAGAGC ATTACGCTGA CTTGACGGGA
1321 CGGCGNCAATG ACCAAAATCC CTTAACGTGA GTTTTCGTTT CACTGAGCGT CAGACCCCGT
1381 AGAAAAGATC AAAGGATCTT CTTGAGATCC TTTTTTCTG CGCGTAATCT GCTGCTTGCA
1441 AACAAAAAAA CCACCGCTAC CAGCGGTGGT TTGTTTGCCG GATCAAGAGC TACCAACTCT
1501 TTTTCCGAAG GTAACCTGGT TCAGCAGAGC GCAGATACCA AATACTGTCC TTCTAGTGTA
1561 GCCGTAGTTA GGCCACCACT TCAAGAACTC TGTAGCACCG CCTACATACC TCGCTCTGCT
1621 AATCCTGTTA CCAGTGGCTG CTGCCAGTGG CGATAAGTCG TGTCTTACCG GGTGGGACTC
1681 AAGACGATAG TTACCGGATA AGGCGCAGCG GTCGGGCTGA ACGGGGGGTT CGTGACACACA
1741 GCCCAGCTTG GAGCGAACGA CCTACACCGA ACTGAGATAC CTACAGCGTG AGCTATGAGA
1801 AAGCGCCACG CTTCCCGAAG GGAGAAAGGC GGACAGGTAT CCGGTAAGCG GCAGGGTCGG
1861 AACAGGAGAG CGCACGAGGG AGCTTCCAGG GGGAAACGCC TGGTATCTTT ATAGTCTGT
1921 CGGGTTTCGC CACCTCTGAC TTGAGCGTCG ATTTTGTGTA TGCTCGTCAG GGGGGCGGAG
1981 CCTATGGAAA AACGCCAGCA ACGCGGCCTT TTTACGGTTC CTGGCCTTTT GCTGGCCTTT
2041 TGCTCACATG TTCTTCCCTG CGTTATCCCC TGATTCTGTG GATAACCGTA TTACCGCTAG
2101 CTGGATCGGC AAATAATGAT TTTATTTTGA CTGATAGTGA CCTGTTGTTT GCAACAAATT
2161 GATAAGCAAT GCTTTTTTAT AATGCCAAT TTGTACAAGA AAGCTGAACG AGAAACGTAA
2221 AATGATATAA ATATCAATAT ATTAATAATT ATTTTGCATA AAAAACAGAC TACATAATAC
2281 TGTAACACAC AACATATCCA GTCATATGTA TTCAACTACT TAGATGGTAT TAGTGACCTG
2341 TAGTCGACTA AGTTGGCAGC ATCACCAGAC GCACTTTGCG CCGAATAAAT ACCTGTGACG
2401 GAAGATCACT TCGCAGAATA AATAAATCCT GGTGTCCCTG TTGATACCGG GAAGCCCTGG
2461 GCCAATTTT GCGGAAAATG AGACGTTGAT CGGCACATTT CACAACTCTT ATACTTTTCT
2521 CTTACAAGTC GTTCGGCTTC ATCTGGATTT TCAGCCTCTA TACTTACTAA ACGTGATAAA
2581 GTTCTGTGTA TTTCTACTGT ATCGACCTGC AGACTGGCTG TGTATAACGG AGCCTGACAT
2641 TTATATTTCC CAGAATCA GGTAAATGGC GTTTTGTATG TCATTTTCGC GGTGGCTGAG
2701 ATCAGCCACT TCTTCCCCGA TAACGGAGAC CGGCACACTG GCCATATCGG TGGTCATCAT
2761 GCGCCAGCTT TCATCCCCGA TATGCACCAC CGGGTAAAGT TCACGGGAGA CTTTATCTGA
2821 CAGCAGACGT GCACTGGCCA GGGGATACAC CATCCGTCGC CCGGGCGTGT CAATAATATC
2881 ACTCTGTACA TCCACAAACA GACGATAACG GCTCTCTCTT TTATAGGTGT AAACCTTAAA
2941 CTGCATTTCA CCAGTCCCTG TTCTCGTCAG CAAAAGAGCC GTTCATTTCA ATAAACGGG
3001 CGACCTCAGC CATCCCTTCC TGATTTTCCG CTTTCCAGCG TTCGGCACGC AGACGACGGG
3061 CTTCAATTCTG CATGGTTGTG CTTACCAGAC CGGAGATATT GACATCATAT ATGCCTTGAG
3121 CAACTGATAG CTGTCGCTGT CAACTGTCAC TGTAATACGC TGCTTCATAG CACACCTCTT-

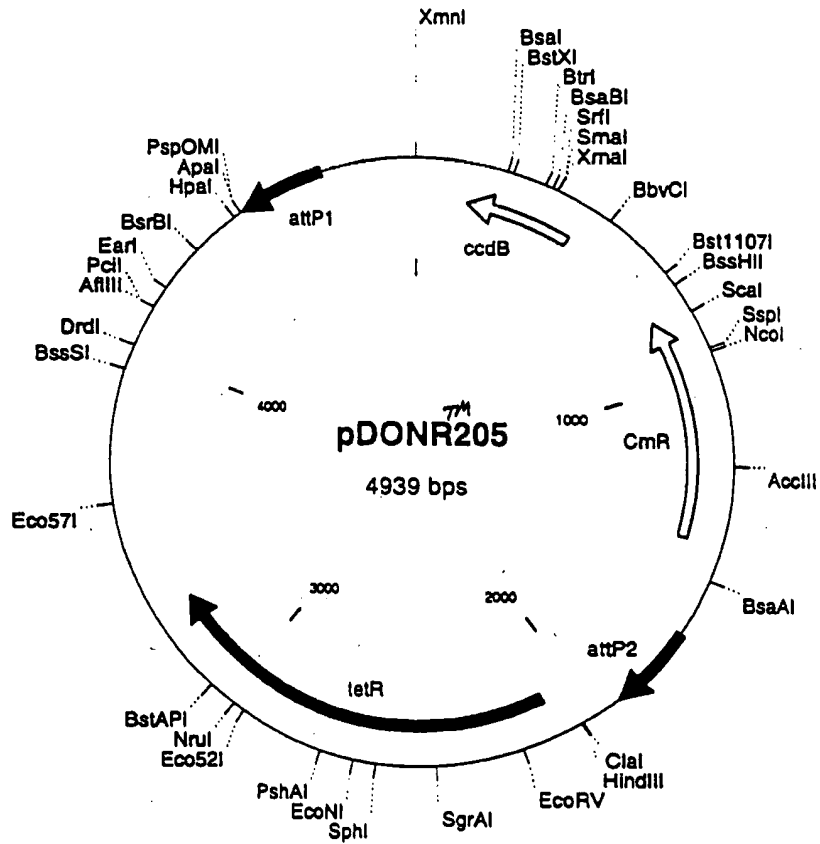
FIGURE 52B

3181 TTTGACATAC TTCGGGTATA CATATCAGTA TATATTCTTA TACCGCAAAA ATCAGCGCGC
3241 AAATACGCAT ACTGTTATCT GGCTTTTAGT AAGCCGGATC CACGCGTTTA CGCCCCGCCC
3301 TGCCACTCAT CGCAGTACTG TTGTAATTCA TTAAGCATTG TGCCGACATG GAAGCCATCA
3361 CAGACGGCAT GATGAACCTG AATCGCCAGC GGCATCAGCA CCTTGTGCGC TTGCGTATAA
3421 TATTTGCCCA TGGTGAAAAC GGGGGCGAAG AAGTTGTCCA TATTGGCCAC GTTTAAATCA
3481 AAAGTGGTGA AACTCACCCA GGGATTGGCT GAGACGAAAA ACATATTCTC AATAAACCCCT
3541 TTAGGGAAAT AGGCCAGGTT TTCACCGTAA CACGCCACAT CTTGCGAATA TATGTGTAGA
3601 AACTGCCGGA AATCGTCGTG GTATTCACTC CAGAGCGATG AAAACGTTTC AGTTTGCTCA
3661 TGGAAAACGG TGTAACAAGG GTGAACACTA TCCCATATCA CCAGCTCACC GTCTTTCATT
3721 GCCATACGGA ATTCCGGATG AGCATTATC AGGCGGGCAA GAATGTGAAT AAAGGCCGGA
3781 TAAAACTTGT GCTTATTTTT CTTTACGGTC TTTAAAAAGG CCGTAATATC CAGCTGAACG
3841 GTCTGGTTAT AGGTACATTG AGCAACTGAC TGAAATGCCT CAAAATGTTC TTTACGATGC
3901 CATTGGGATA TATCAACGGT GGTATATCCA GTGATTTTTT TCTCCATTTT AGCTTCCTTA
3961 GTCCTGAAA ATCTCGATAA CTCAAAAAAT ACGCCCGGTA GTGATCTTAT TTCATTATGG
4021 TGAAAGTTGG AACCTCTTAC TGTTCTTGAT GCAGATGATT TTCAGGACTA TGACACTAGC
4081 ATATATGAAT AGGTAGATGT TTTTATTTTG TCACACAAAA AAGAGGCTCG CACCTCTTTT
4141 TCTTATTTCT TTTTATGATT TAATA

FIGURE 52C

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Figure 53A: pDONR205 (tetR)



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pDONR205 4939 bp

GGCATCAGCACCTTGTGCGCTTGCGTATAATATTTGCCCATGGTGAAAACGGGGGCGAAG
AAGTTGTCCATATTGGCCACGTTTAAATCAAAACTGGTGAAACTCACCAGGGATTGGCT
GAGACGAAAAACATATTCTCAATAAACCCCTTTAGGGAAATAGGCCAGGTTTTACCGTAA
CACGCCACATCTTGCGAATATATGTGTAGAACTGCCGGAATCGTCGTGGTATTCACTC
CAGAGCGATGAAAACGTTTCAGTTTGCTCATGAAAACGGGTGTAACAAGGGTGAACACTA
TCCCATATCACCAGCTCACCCTCTTTTCATTGCCATACGGAATCCGGATGAGCATTTCATC
AGGCGGGCAAGAATGTGAATAAAGGCCGATAAAACTTGTGCTTATTTTTCTTTACGGTC
TTTAAAAAGGCCGTAATATCCAGCTGAACGGTCTGGTTATAGGTACATTGAGCAACTGAC
TGAAATGCCTCAAAATGTTCTTTACGATGCCATTGGGATATATCAACGGTGGTATATCCA
GTGATTTTTTTCTCCATTTTAGCTTCTTAGCTCCTGAAAATCTCGATAACTCAAAAAAT
ACGCCCGGTAGTGATCTTATTTTATTATGGTGAAAGTTGGAACCTCTTACGTGCCGATCA
ACGTCCTATTTTCGCCAAAAGTTGGCCCGAGGGCTTCCCGGTATCAACAGGGACACCAGGA
TTTATTTATTCTGCGAAGTGATCTTCCGTACAGGTATTTATTCGGCGCAAAGTGCGTCG
GGTGATGCTGCCAACTTAGTCGACTACAGGTCACATAACCATCTAAGTAGTTGATTCAT
AGTGACTGGATGTTGTGTTTTACAGTATTATGTAGTCTGTTTTTATGCAAAATCTAA
TTTAAATATTGATATTATATCATTTTACGTTTCTCGTTTCAGCTTTCTTGTAAGTT
GGCATTATAAGAAAGCATTGCTTATCAATTTGTTGCAACGAACAGGTCACATCAGTCAA
AATAAAATCATTATTTGCCATCCAGCTGCAGCTCTGGCCCGTGTCTCAAAATCTCTGATG
TTACATTGCACAAGATAAAAAATATATCATCATGAATCTCATGTTTGACAGCTTATCATC
GATAAGCTTTAATGCGGTAGTTTATCACAGTTAAATTGCTAACGCAGTCAGGCACCGTGT
ATGAAATCTAACAATGCGCTCATCGTCATCTCGGCACCGTCACCCTGGATGCTGTAGGC
ATAGGCTTGGTTATGCGCGTACTGCCGGGCTCTTGCGGGATATCGTCCATTCCGACAGC
ATCGCCAGTCACATATGGCGTGCTGTAGCGCTATATGCGTTGATGCAATTTCTATGCGCA
CCCCTTCTCGGAGCACTGTCCGACCGCTTTGGCCGCGCCAGTCCTGTCTCGCTTCGCTA
CTTGAGGCCACTATCGACTACGCGATCATGGCGACCACACCCGTCCTGTGGATCCTCTAC
GCCGACGCATCGTGCCCGGCATCACCGGCGCCACAGGTGCGGTTGCTGGCGCCTATATC
GCCGACATCACCAGTGGGGAAGATCGGGCTCGCCACTTCGGGCTCATGAGCGCTTGTTTC
GGCGTGGGTATGGTGGCAGGCCCGGTGGCCGGGGGACTGTTGGGCGCCATCTCCTTGAT
GCACCATTCCTTGCGCGCGCGGTGCTCAACGGCCTCAACCTACTACTGGGCTGCTTCCTA
ATGCAGGAGTCGCATAAGGGAGAGCGTCGACCGATGCCCTTGAGAGCCTTCAACCCAGTC
AGTCCTTCCGGTGGCGCGCGGGCATGACTATCGTCGCCGCACTTATGACTGTCTTCTTT
ATCATGCAACTCGTAGGACAGGTGCCGCGAGCGCTCTGGGTCAATTTTCGGCGAGGACCGC
TTTCGCTGGAGCGCGACGATGATCGGCCTGTGCTTGGCGTATTCGGAATCTTGACGCGC
CTCGCTCAAGCCTTCGTCACTGGTCCCGCCACCAACGTTTCGGCGAGAAGCAGGCCATT
ATCGCCGGCATGGCGGCCGACGCGCTGGGCTACGTCTTGCTGGCGTTCCGACGCGAGGC
TGGATGGCCTTCCCATTTATGATTTCTCTCGCTTCCGGCGGCATCGGGATGCCCGCGTTG
CAGGCCATGCTGTCCAGGCAGGTAGATGACGACCATCAGGGACAGCTTCAAGGATCGCTC
GCGGCTCTTACCAGCCTAACTTCGATCATTGGACCGCTGATCGTCACGGCGATTTATGCC
GCCTCGGCGAGCACATGGAACGGGTTGGCATGGATTGTAGGCGCGCCCTATACCTTGTC
TGCTCCCCGCGTTGCGTGCCTGCGGTGATGGAGCCGGGCCACCTCGACCTGAATGGAAGCC
GGCGGCACCTCGCTAACGGATTCAACACTCCAAGAATTGGAGCCAATCAATCTTGCGGA
GAACTGTGAATGCGCAACCAACCCCTTGGCAGAACATATCCATCGCATGACCAAAATCCC
TTAACGTGAGTTTTCTGTTCCACTGAGCGTCAGACCCCGTAGAAAAGATCAAAGGATCTTC
TTGAGATCCTTTTTTCTGCGCGTAATCTGCTGCTTGCAAAACAAAAAACACCGCTACC
AGCGGTGGTTTTGTTTGCCGGATCAAGAGCTACCAACTCTTTTTCCGAAGGTAAGTGGCTT
CAGCAGAGCGCAGATACCAATACTGTCTTCTAGTGTAGCCGTAAGTGGCCACCACTT
CAAGAACTCTGTAGCACCGCTTACATACCTCGCTCTGCTAATCCTGTTACCAGTGGCTGC
TGCCAGTGGCGATAAGTCGTGCTTACCAGGGTTGGACTCAAGACGATAGTTACCGGATAA
GGCGCAGCGGTCCGGCTGAACGGGGGGTTCGTGCACACAGCCAGCTTGAGAGCAACGAC
CTACACCGAACTGAGATACCTACAGCGTGAGCTATGAGAAAGCGCCACGCTTCCGAAGG
GAGAAAGGCGGACAGGTATCCGGTAAGCGGCAGGGTCGGAACAGGAGAGCGCACGAGGGA
GCTTCCAGGGGGAAACGCGCTGGTATCTTTATAGTCTGTGCGGTTTTCGCCACCTCTGACT
TGAGCGTCGATTTTTGTGATGCTCGTCAGGGGGGCGGAGCCTATGGAACACGCCAGCAA-

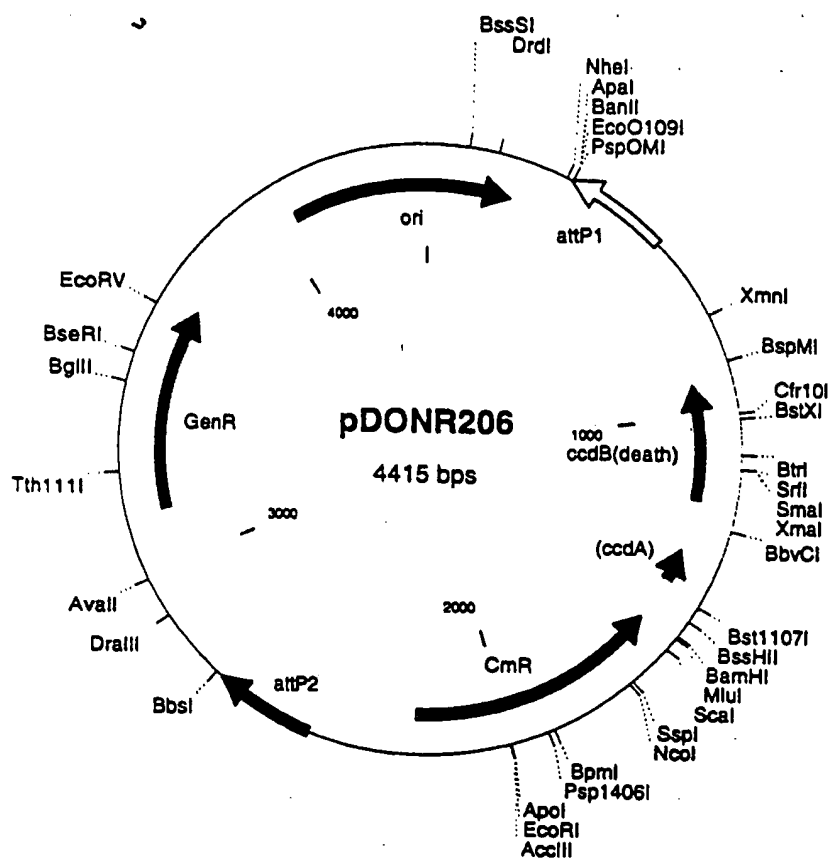
FIGURE 53B

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CGCGGCCTTTTTACGGTTCCTGGCCTTTTGCTGGCCTTTTGCTCACATGTTCTTCTCTGC
GTTATCCCCTGATTCTGTGGATAACCGTATTACCGCTAGCCAGGAAGAGTTTGTAGAAAC
GCAAAAAGGCCATCCGTCAGGATGGCCTTCTGCTTAGTTTGTATGCCTGGCAGTTTATGGC
GGGCGTCTCTGCCCGCCACCCTCCGGGCGGTTGCTTCACAACGTTCAAATCCGCTCCCGGC
GGATTTGTCTACTCAGGAGAGCGTTACCCGACAAACAACAGATAAAACGAAAGGCCAG
TCTTCCGACTGAGCCTTTCGTTTTATTGTATGCCTGGCAGTTCCCTACTCTCGCGTTAAC
GCTAGCATGGATCTCGGGCCCCAAATAATGATTTTATTTTGTACTGATAGTGACCTGTTTCG
TTGCAACAAATTGATGAGCAATGCTTTTTTATAATGCCAACTTTGTACAAAAAAGCTGAA
CGAGAAACGTAAATGATATAAATATCAATATATTAAATTAGATTTTGCATAAAAAACAG
ACTACATAATACTGTAAACACAACATATCCAGTCACTATGAATCAACTACTTAGATGGT
ATTAGTGACCTGTAGTCGACCGACAGCCTTCCAAATGTTCTTCGGGTGATGCTGCCAACT
TAGTCGACCGACAGCCTTCCAAATGTTCTTCTCAAACGGAATCGTCGTATCCAGCCTACT
CGCTATTGTCTCAATGCCGTATTAAATCATAAAAAGAAATAAGAAAAAGAGGTGCGAGC
CTCTTTTTTGTGTGACAAAAATAAAAAACATCTACCTATTCATATACGCTAGTGTCTAGTC
CTGAAATCATCTGCATCAAGAACAATTCACAACCTCTTATACTTTTCTCTTACAAGTCG
TTCGGCTTCATCTGGATTTTCAGCCTCTATACTTACTAAACGTGATAAAGTTTCTGTAAT
TTCTACTGTATCGACCTGCAGACTGGCTGTGTATAAGGGAGCCTGACATTTATATTTCCCC
AGAACATCAGGTTAATGGCGTTTTTGTATGTCATTTTCGCGGTGGCTGAGATCAGCCACTT
CTTCCCCGATAACGGAGACCGGCACACTGGCCATATCGGTGGTTCATCATGCGCCAGCTTT
CATCCCCGATATGCACCACCGGGTAAAGTTTACGGGAGACTTTATCTGACAGCAGACGTG
CACTGGCCAGGGGATCACCATCCGTGCGCCGGGCGTGTCAATAATATCACTCTGTACAT
CCACAAACAGACGATAACGGCTCTCTCTTTTATAGGTGTAAACCTTAACTGCATTTAC
CAGTCCCTGTTCTCGTCAGCAAAAGAGCCGTTCAATTTCAATAAACCGGGCGACCTCAGCC
ATCCCTTCCTGATTTTTCGGCTTTCCAGCGTTCGGCACGCAGACGACGGGCTTCATTCTGC
ATGGTTGTGCTTACCAGACCGGAGATATTGACATCATATATGCCTTGAGCAACTGATAGC
TGTCGCTGTCAACTGTCACTGTAATACGCTGCTTCATAGCACACCTCTTTTGTACATACT
TCGGGTATACATATCAGTATATATTCTTATACCGCAAAAATCAGCGCGCAAAATACGCATA
CTGTTATCTGGCTTTTAGTAAGCCGGATCCACGCGATTACGCCCCGCCCTGCCACTCATC
GCAGTACTGTTGTAATTCATTAAGCATTCTGCCGACATGGAAGCCATCACAGACGGCATG
ATGAACCTGAATCGCCAGC

FIGURE 53C

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pDONR206 4415 bp

CGGCATTGAGGACAATAGCGAGTAGGCTGGATACGACGATTCCGTTTGAGAAGAACATTT
GGAAGGCTGTCGGTCGACTACAGGTCACTAATACCATCTAAGTAGTTGAATCATAGTGAC
TGGATATGTTGTGTTTTACAGTATTATGTAGTCTGTTTTTTATGCAAAATCTAATTTAAT
ATATTGATATTTATATCATTTTACGTTTCTCGTTCAGCTTTTTTGTACAAAGTTGGCATT
ATAAAAAAGCATTGCTTATCAATTTGTTGCAACGAACAGGTCATATCAGTCAAAATAAA
ATCATTATTTGGGGCCCCGAGATCCATGCTAGCGGTAATACGGTTATCCACAGAATCAGGG
GATAACGCAGGAAAGAACATGTGAGCAAAAGGCCAGCAAAAGGCCAGGAACCGTAAAAAG
GCCGCGTTGCTGGCGTTTTTCCATAGGCTCCGCCCCCTGACGAGCATCACAAAAATCGA
CGCTCAAGTCAGAGGTGGCGAAACCCGACAGGACTATAAAGATACCAGGCGTTTCCCCCT
GGAAGCTCCCTCGTGCGCTCTCCTGTTCCGACCCTGCCGCTTACCGGATACCTGTCCGCC
TTTCTCCCTTCGGGAAGCGTGGCGCTTCTCATAGCTCACGCTGTAGGTATCTCAGTTCCG
GTGTAGGTGCTTCCGCTCCAAGCTGGGCTGTGTGCACGAACCCCCCGTTCAGCCCGACCGC
TGCGCCTTATCCGGTAACTATCGTCTTGAGTCCAACCCGGTAAGACACGACTTATCGCCA
CTGGCAGCAGCCACTGGTAACAGGATTAGCAGAGCGAGGTATGTAGGCGGTGTACAGAG
TTCTTGAAGTGGTGGCCTAACTACGGCTACACTAGAAGGACAGTATTGGTATCTGCGCT
CTGCTGAAGCCAGTTACCTTCGGAAAAAGAGTTGGTAGCTCTTGATCCGGCAAAACAAACC
ACCGCTGGTAGCGGTGTTTTTTTTGTTTGCAAGCAGCAGATTACGCGCAGAAAAAAGGA
TCTCAAGAAGATCCTTTGATCTTTTCTACGGGGTCTGACGCTCAGTGGAACGAAAACTCA
CGTTAAGGGATTTTGGTCATGNCGCCGTCCCGTCAAGTCAGCGTAATGCTCTGCCAGTGT
TACAACCAATTAACCAATTCTGATTAGAAAACTCATCGAGCATCAAATGAACTGCAAT
TTATTCATATCAGGATTATCAATACCATATTTTTGAAAAAGCCGTTTCTGTAATGAAGGA
GAAAACTCACCGAGGCAGTTCCATAGGATGGCAAGATCCTGGTATCGGTCTGCGATTCCG
ACTCGTCCAACATCAATACAACCTATTAGCCGAGGTCTTCCGATCTCCTGAAGCCAGGGC
AGATCCGTGCACAGCACCTTGCCGTAGAAGAACAGCAAGGCCGCAATGCCTGACGATGC
GTGGAGACCGAAACCTTGCGCTCGTTCCGACAGCAGGACAGAAATGCCTCGACTTCGCTG
CTGCCCAAGGTTGCCGGTGACGCACACCGTGGAACCGGATGAAGGCACGAACCCAGTTG
ACATAAGCCTGTTCCGTTTCGTAACTGTAATGCAAGTAGCGTATGCGCTCACGCAACTGG
TCCAGAACCTTGACCGAACGCAGCGGTGGTAACGGCGCAGTGGCGGTTTTTCATGGCTTGT
TATGACTGTTTTTTTTGTACAGTCTATGCCCTCGGGCATCCAAGCAGCAAGCGCGTTACGCC
GTGGGTGATGTTTGTATGTTATGGAGCAGCAACGATGTTACGCAGCAGCAACGATGTTAC
GCAGCAGGGCAGTCGCCCTAAAACAAAGTTAGGTGGCTCAAGTATGGGCATCATTCCGCAC
ATGTAGGCTCGGCCCTGACCAAGTCAAATCCATGCGGGCTGCTCTTGATCTTTTCGGTCCG
TGAGTTCCGAGACGTAGCCACCTACTCCCAACATCAGCCGGACTCCGATTACCTCGGGAA
CTTGCTCCGTAGTAAGACATTATCGCGCTTGCTGCCTTCGACCAAGAAGCGGTTGTTGG
CGCTCTCGCGGCTTACGTTCTGCCCAGGTTTGAGCAGCCGCGTAGTGAGATCTATATCTA
TGATCTCGCAGTCTCCGGCAGCAGCCGAGGCGAGGCGATTGCCACCGCGCTCATCAATCT
CCTCAAGCATGAGGCCAACCGCGCTTGGTGCTTATGTGATCTACGTGCAAGCAGATTACGG
TGACGATCCCGCAGTGGCTCTCTATACAAAGTTGGGCATACGGGAAGAAGTGATGCACTT
TGATATCGACCCAAGTACCGCCACCTAACAATTGTTCAAGCCGAGATCGGCTTCCCGGC
CTAATTTCCCTCGTCAAAAATAAGGTTATCAAGTGAGAAATCACCATGAGTGACGACTG
AATCCGGTGAGAATGGCAAAAGCGTATGCATTTCTTTCCAGACTTGTTCAACAGGCCAGC
CATTACGCTCGTCATCAAAATCACTCGCATCAACCAAAACCGTTATTCATTTCGTGATTGCG
CCTGAGCGAGACGAAATACGCGATCGCTGTTAAAAGGACAATTACAAAACAGGAATCGAAT
GCAACCGGCGCAGGAACACTGCCAGCGCATCAACAATATTTTACCCTGAATCAGGATATT
CTTCTAATACCTGGAATGCTGTTTTCCCGCGGATCGCAGTGGTGAGTAACCATGCATCAT
CAGGAGTACGGAATAAATGCTTGATGGTCGGAAGAGGCATAAATCCGTCAGCCAGTTTA
GTCTGACCATCTCATCTGTAAACATATTGGCAACGCTACCTTTGCCATGTTTCAGAAACA
ACTCTGGCGCATCGGGCTTCCCATACAATCGAAAGATTGTGCGACCTGATTGCCCGACAT
TATCGCGAGCCCATTTATACCCATATAAATCAGCATCCATGTTGGAATTTAATCGCGGCC
TCCAGCAAGACGTTTTCCGTTGAATATGGCTCATAACACCCCTTGATTACTGTTTATGT
AAGCAGACAGTTTTATTGTTTATGATGATATATTTTATCTTGTGCAATGTAACATCAGA
GATTTTGAGACACGGGCCCGCGCACTGCAGCTGGATCGGCAAAATATGATTTTATTTTG
ACTGATAGTGACCTGTTTCGTTGCAACAAATTGATAAGCAATGCTTTTTTATAATGCCAAC -

FIGURE 54B

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TTTGTACAAGAAAGCTGAACGAGAAACGTAAAATGATATAAAATATCAATATATTAAATTA
GATTTTGCATAAAAAACAGACTACATAAATACTGTAAAACACAACATATCCAGTCACTATG
ATTCAACTACTTAGATGGTATTAGTGACCTGTAGTCGACTAAGTTGGCAGCATCACCCGA
CGCACTTTGCGCCGAATAAATACCTGTGACGGAAGATCACTTCGCAGAATAAATAAATCC
TGGTGTCCCTGTTGATACCGGGAAGCCCTGGGCCAACCTTTGGCGAAAATGAGACGTTGA
TCGGCAGCTAAGAGGTTCCAACCTTTACCATAATGAAATAAGATCACTACCGGGCGTATT
TTTTGAGTTATCGAGATTTTCAGGAGCTAAGGAAGCTAAAATGGAGAAAAAATCACTGG
ATATACCACCGTTGATATATCCCAATGGCATCGTAAAGAACATTTTGAGGCATTTTCAGTC
AGTTGCTCAATGTACCTATAACCAGACCGTTTCAGCTGGATATTACGGCCCTTTTAAAGAC
CGTAAAGAAAAATAAGCACAAGTTTTATCCGGCCCTTTATTCACATTCTTGCCCGCCTGAT
GAATGCTCATCCGGAATTCCGTATGGCAATGAAAGACGGTGAGCTGGTGATATGGGATAG
TGTTACCCCTTGTTACACCGTTTTCCATGAGCAAACGTAACGTTTTTCATCGCTCTGGAG
TGAATACCACGACGATTTCCGGCAGTTTCTACACATATATTCGCAAGATGTGGCGTGTTA
CGGTGAAAACCTGGCCTATTTCCCTAAAGGGTTTATTGAGAATATGTTTTTCGTCTCAGC
CAATCCCTGGGTGAGTTTCACAGTTTGTATTTAAACGTGGCCAATATGGACAACCTTCTT
CGCCCCCGTTTTCCCATGGGCAAATATTATACGCAAGGCGACAAGGTGCTGATGCCGCT
GGCGATTTCAGTTTCATCATGCGCTCTGTGATGGCTTCCATGTCCGCAGAATGCTTAATGA
ATTACAACAGTACTGCGATGAGTGGCAGGGCGGGCGTAAACGCGTGGATCCGGCTTACT
AAAAGCCAGATAACAGTATGCGTATTTGCGCGCTGATTTTTCGGGTATAAGAATATATAC
TGATATGTATACCCGAAGTATGTCAAAAAGAGGTGTGCTATGAAGCAGCGTATTACAGTG
ACAGTTGACAGCGACAGCTATCAGTTGCTCAAGGCATATATGATGTCAATATCTCCGGTC
TGGAAGCACAACCATGCAGAATGAAGCCCGTCGTCTGCGTGCCGAACGCTGGAAAGCGG
AAAATCAGGAAGGGATGGCTGAGGTGCGCCGTTTTATTGAAATGAACGGCTCTTTTGCTG
ACGAGAACAGGGACTGGTGAAATGCAGTTTAAGGTTTACACCTATAAAAGAGAGAGCCGT
TATCGTCTGTTTGTGGATGTACAGAGTGATATTATTGACACGCCCCGGGCGACGGATGGTG
ATCCCCCTGGCCAGTGACGCTCTGCTGTCAGATAAAGTCTCCCGTGAACCTTACCCGGTG
GTGCATATCGGGGATGAAAGCTGGCGCATGATGACCACCGATATGGCCAGTGTCGGGTC
TCCGTTATCGGGGAAGAAGTGGCTGATCTCAGCCACCGCGAAAATGACATCAAAAACGCC
ATTAACCTGATGTTCTGGGGAATATAAATGTCAAGGCTCCGTTATACACAGCCAGTCTGCA
GGTCGATACAGTAGAAATTACAGAACTTTATCACGTTTAGTAAGTATAGAGGCTGAAAA
TCCAGATGAAGCCGAACGACTTGTAAGAGAAAAGTATAAGAGTTGTGAAATTGTTCTTGA
TGCAGATGATTTTCAGGACTATGACACTAGCATATATGAATAGGTAGATGTTTTATTTT
GTCACACAAAAAGAGGCTCGCACCTCTTTTCTTATTCTTTTATGATTTAATA

FIGURE 54 C

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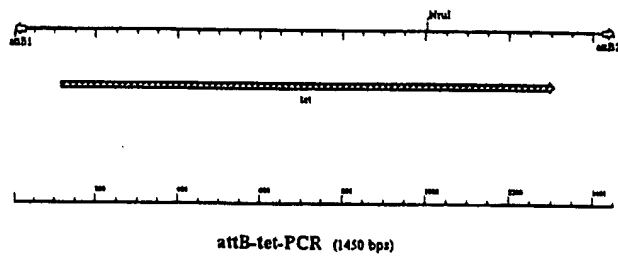
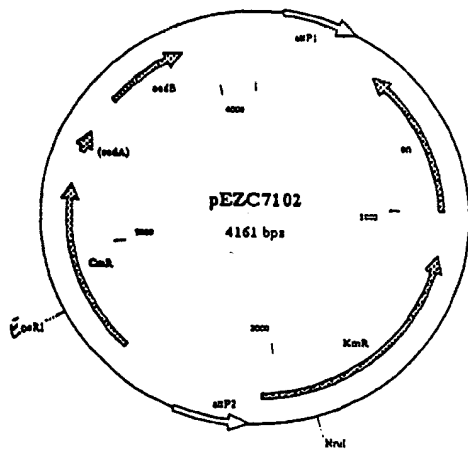


FIGURE 56

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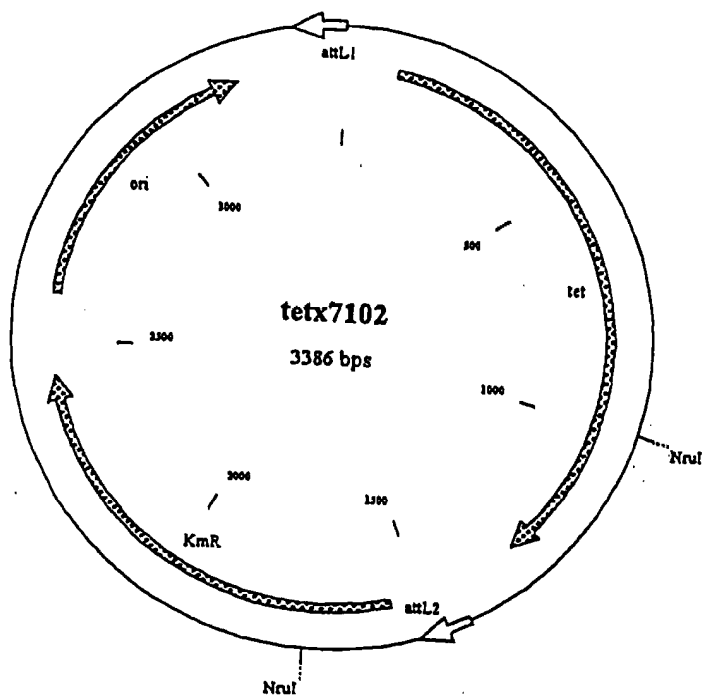


FIGURE 57

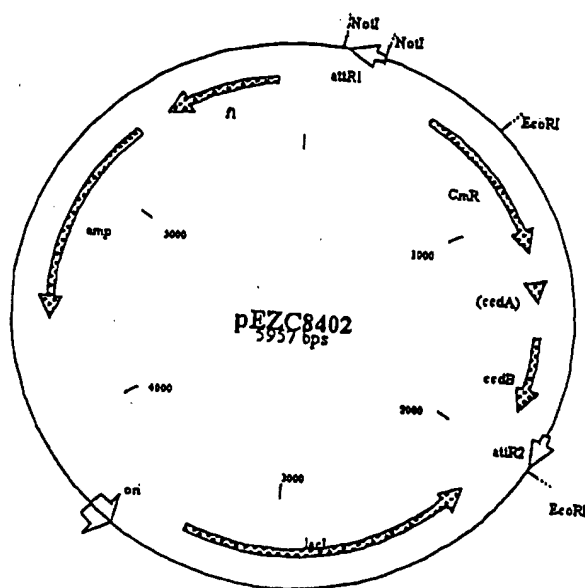


FIGURE 5B

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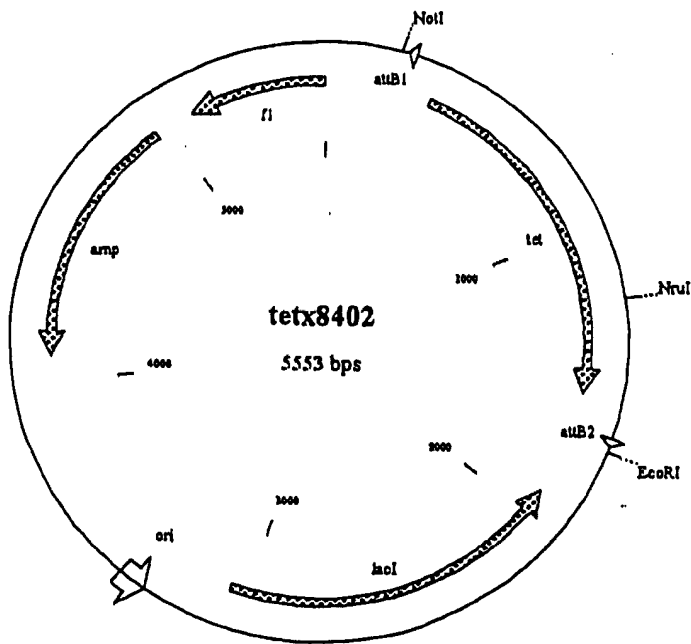


FIGURE 59

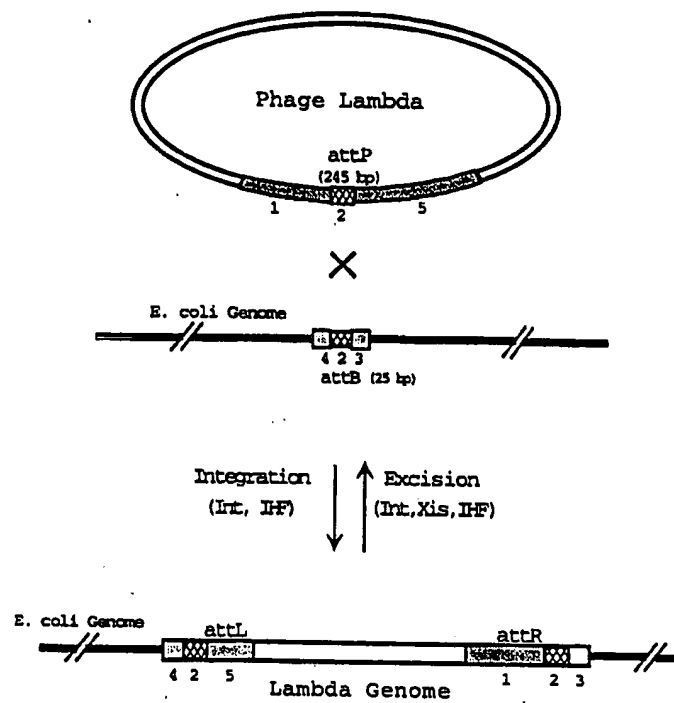


FIGURE 60

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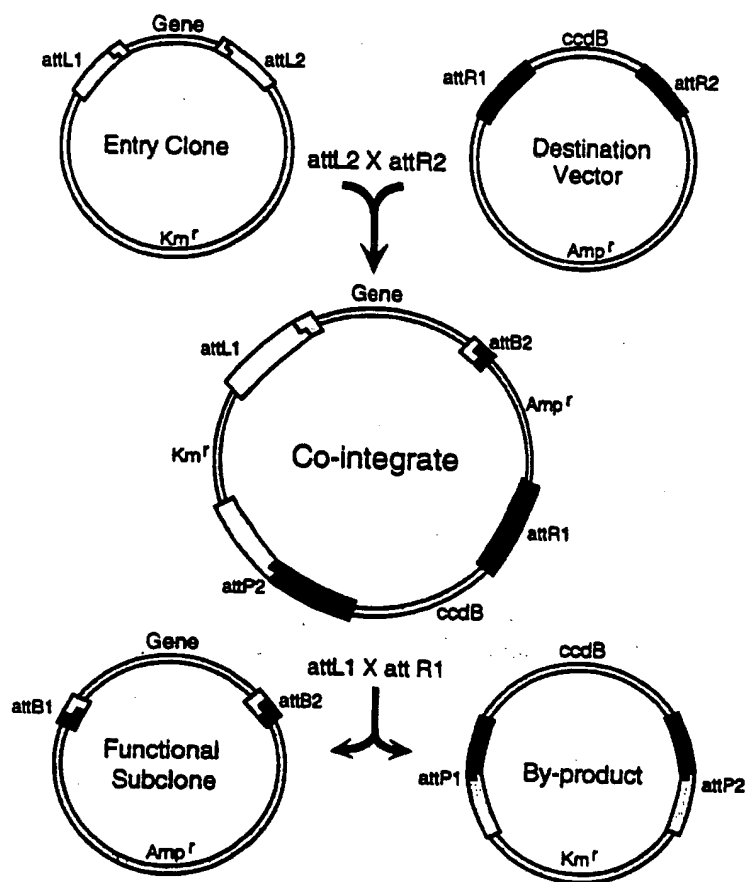


FIGURE 61

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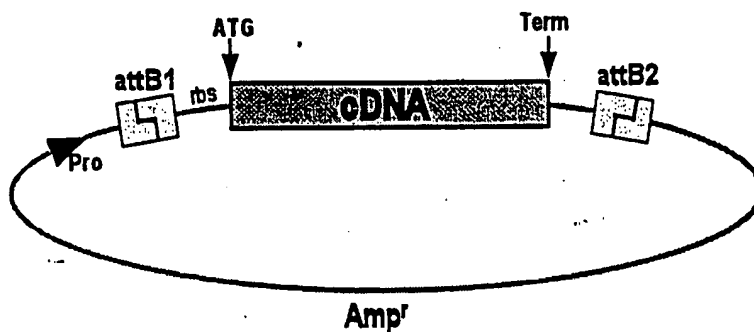
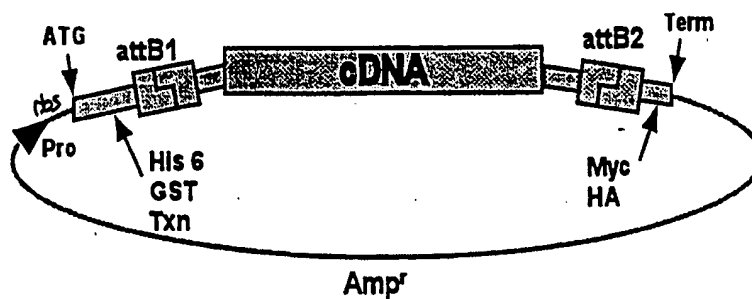
Native Protein Expression:**Fusion Protein Expression:**

FIGURE 62

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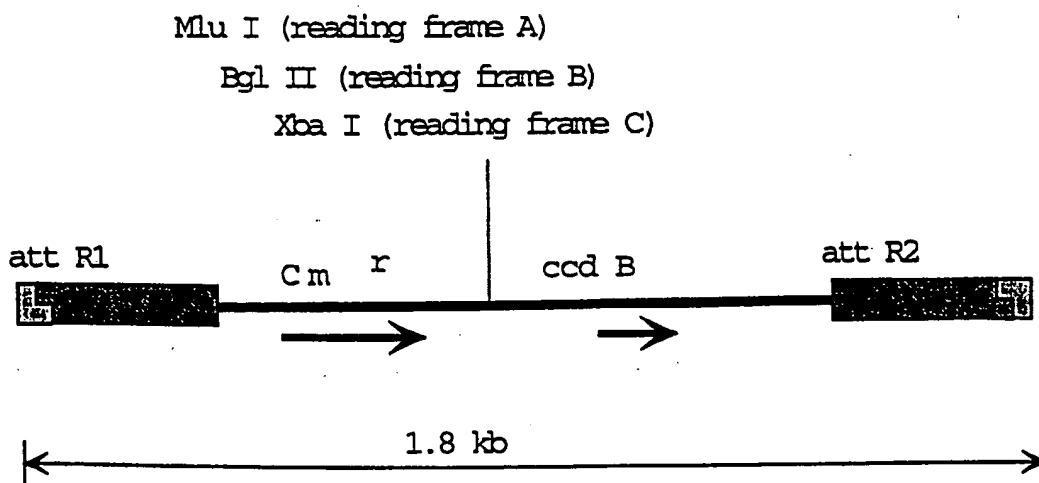


FIGURE 63

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FIGURE 64A

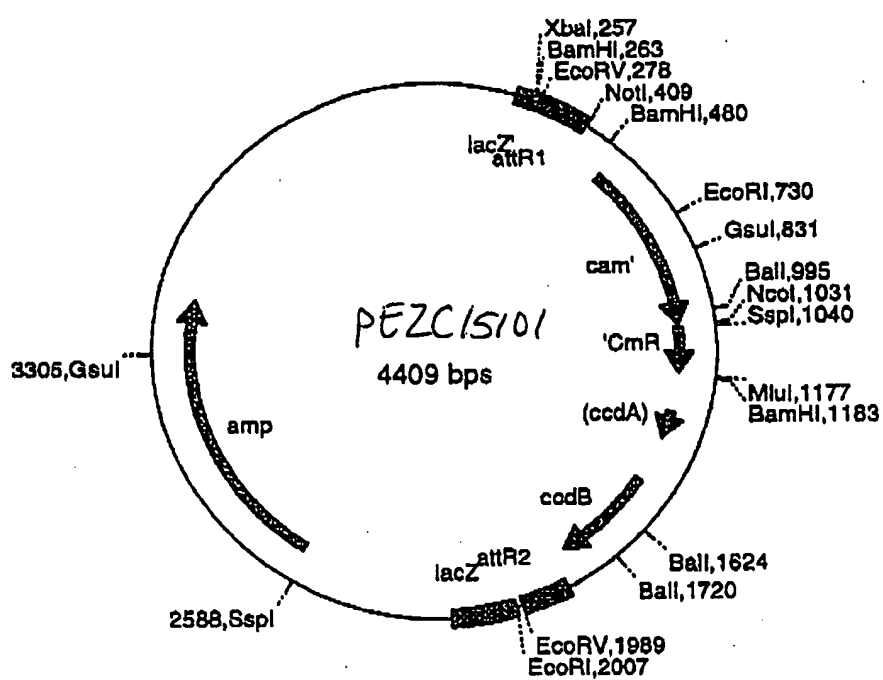


FIGURE 4A

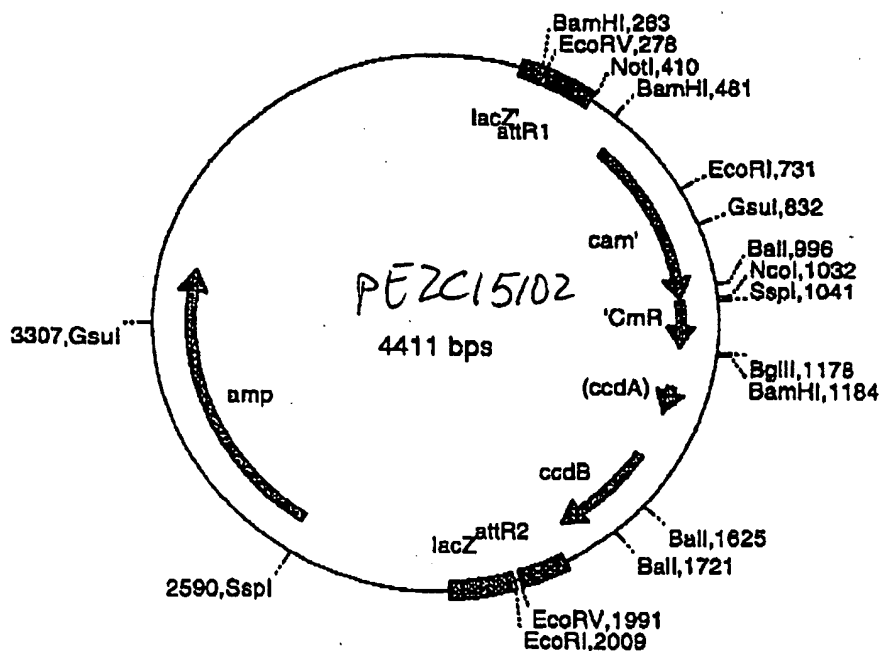
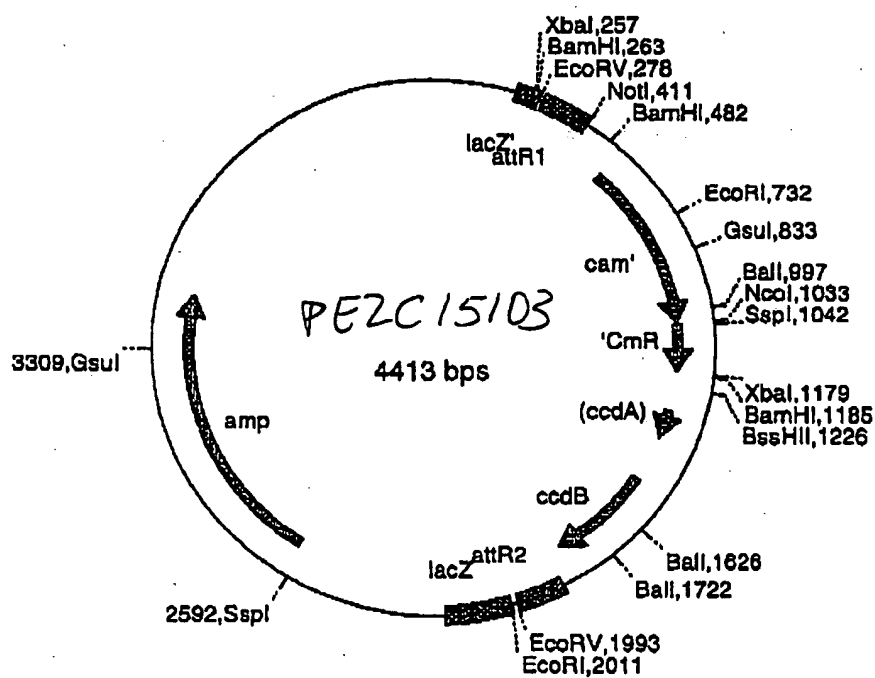
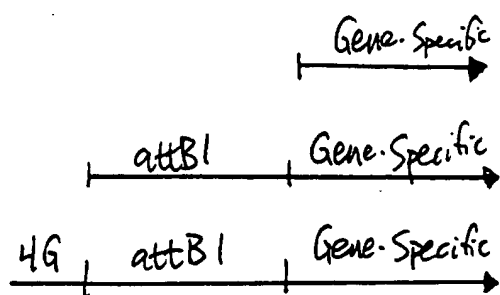


FIGURE 64C



Primers for Amplifying *tetR* and *ampR* for Cloning by Recombination

Primers



Reverse Primers

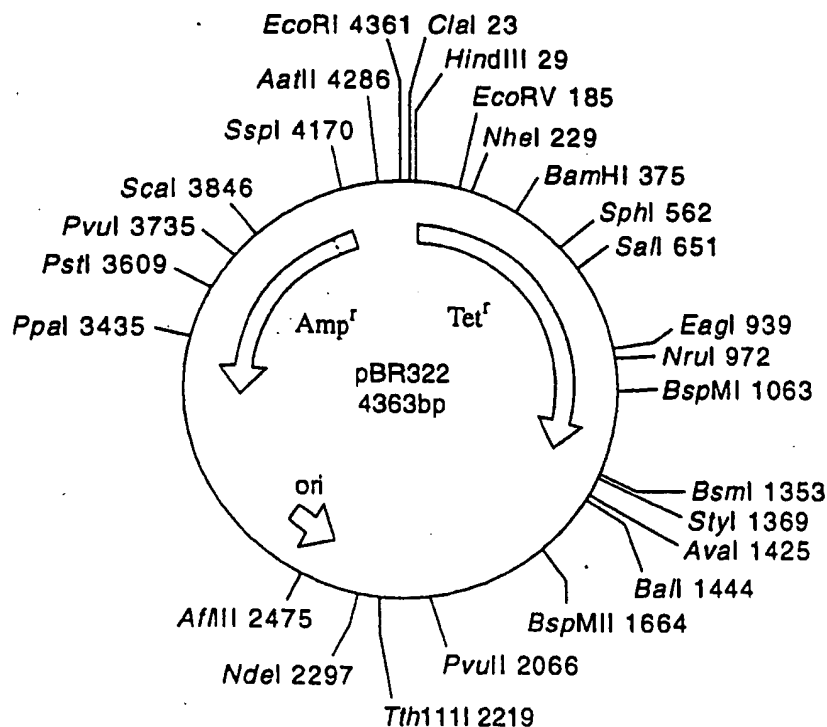
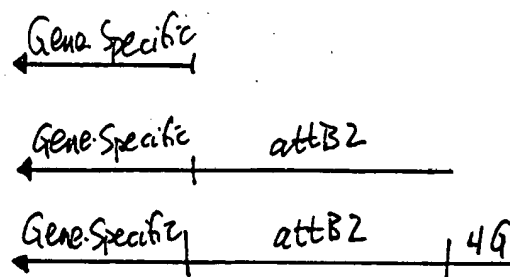


FIGURE 05

**Results of Cloning
tet and amp PCR Products
by Recombination**

PCR Product Used in GCS Reactions	No. Colonies Obtained (100 ul plated)	Form of DNA Analyzed	Colonies Obtained of Predicted Size
tet	6, 10	SC	0 of 8
attB-tet	9, 6	SC	1 of 8
attB+4G-tet	824, 1064	SC AvaI+Bam	7 of 7 7 of 7
amp	7, 13	SC	0 of 8
attB-amp	18, 22	SC	3 of 8
attB+4G-amp	3020, 3540	SC PstI	8 of 8 8 of 8
attB Plasmid (Pos. Control)	320, 394		

FIGURE 66

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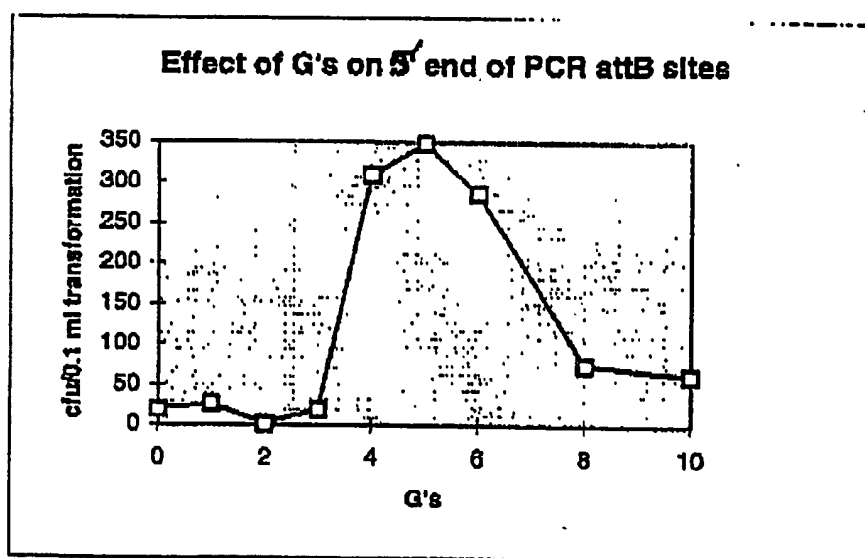


FIGURE 67

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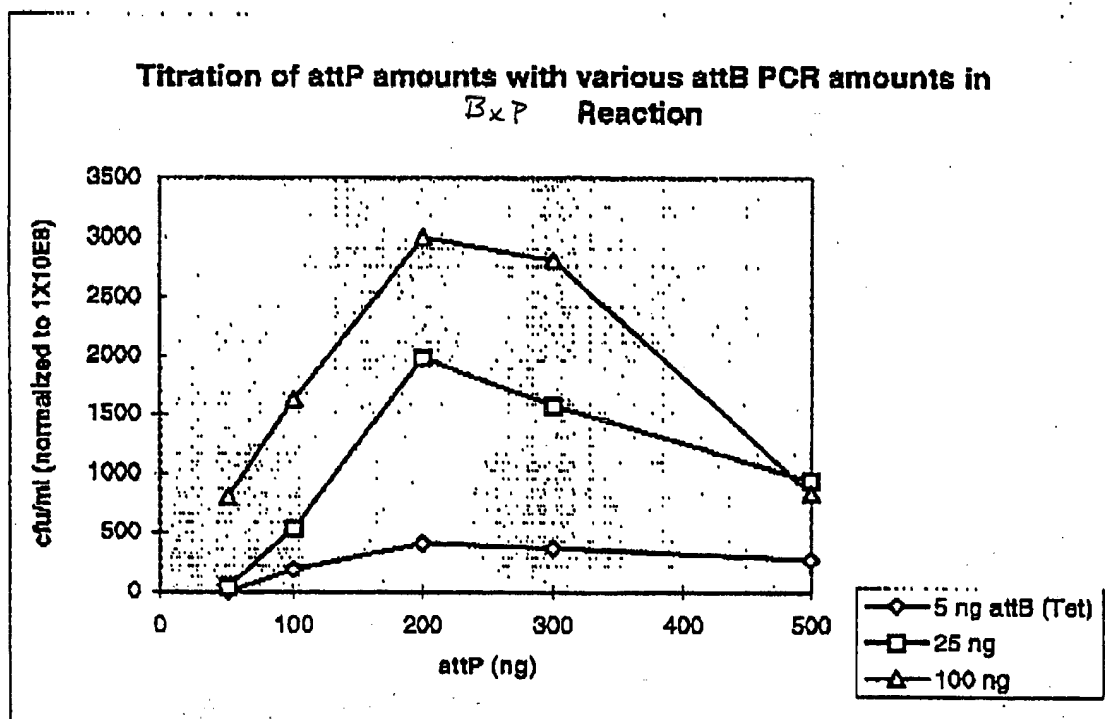


FIGURE 68

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FIGURE
69

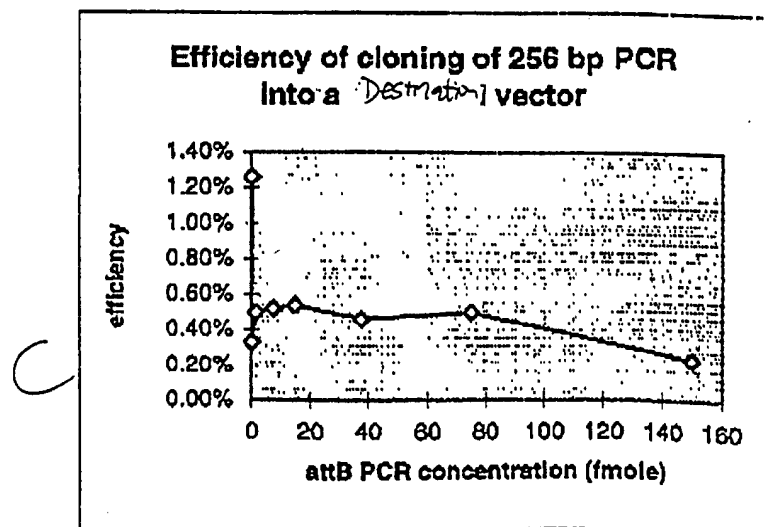
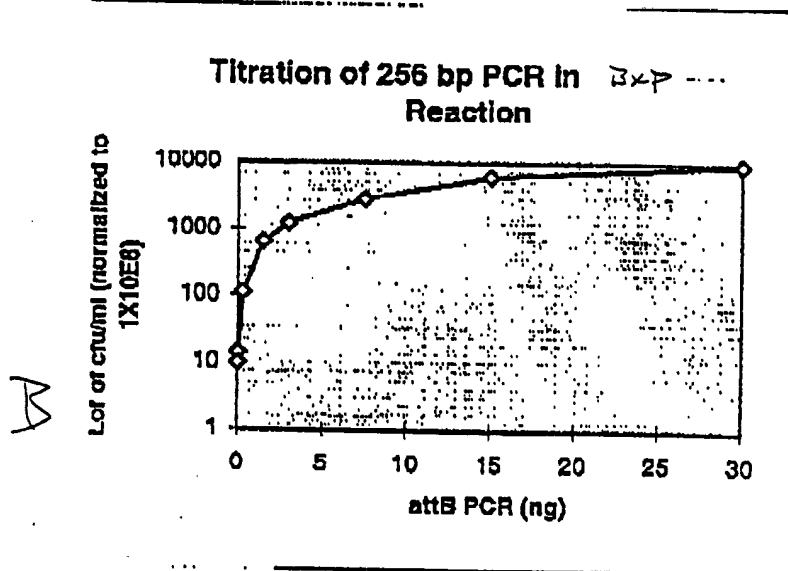
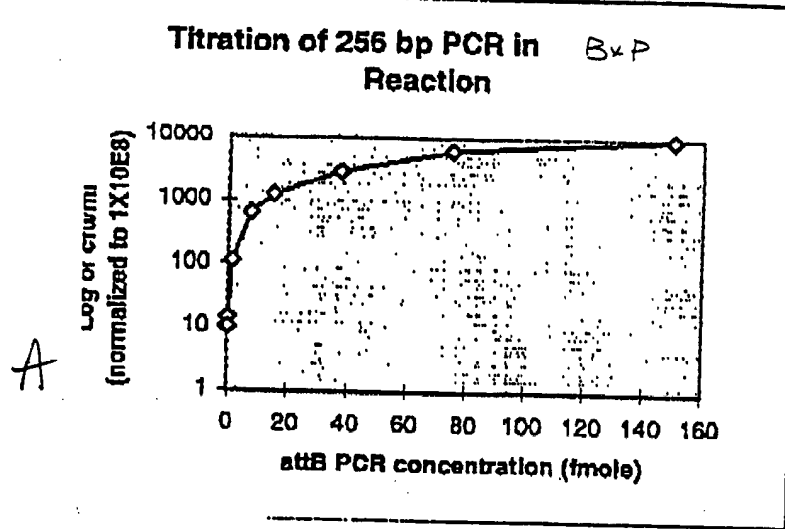
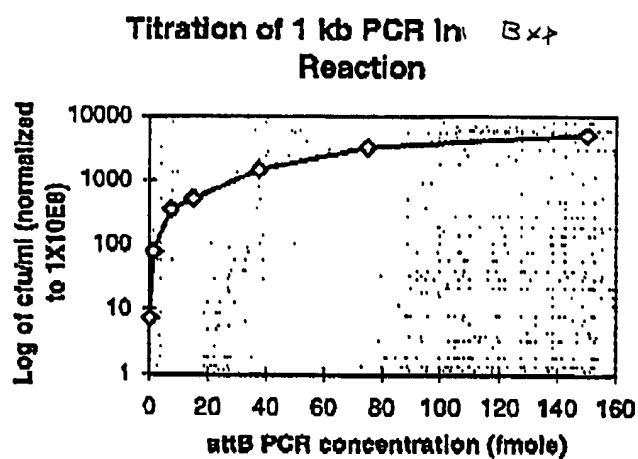
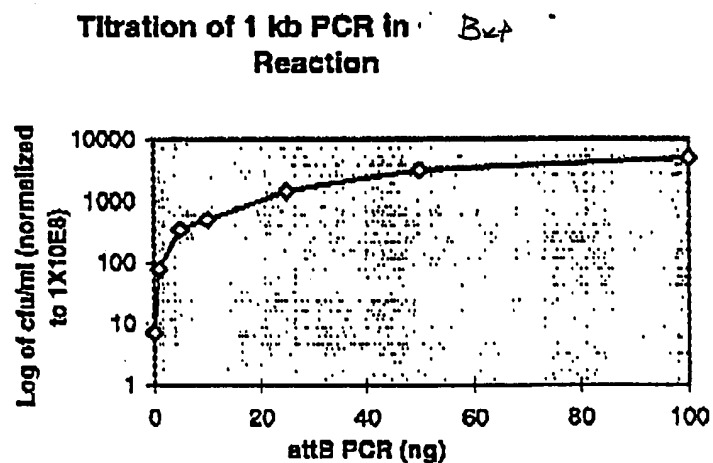


FIGURE
70

A



B



C

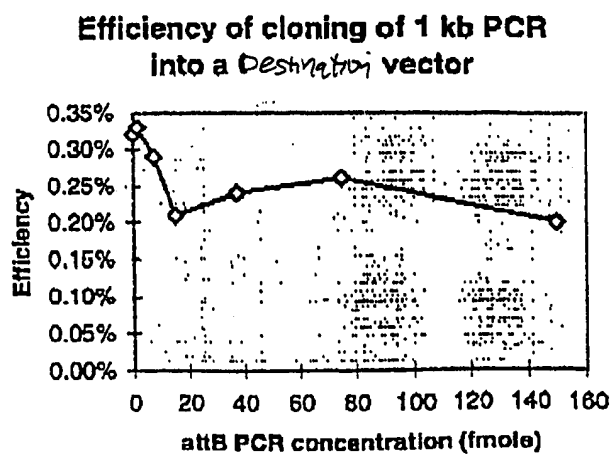
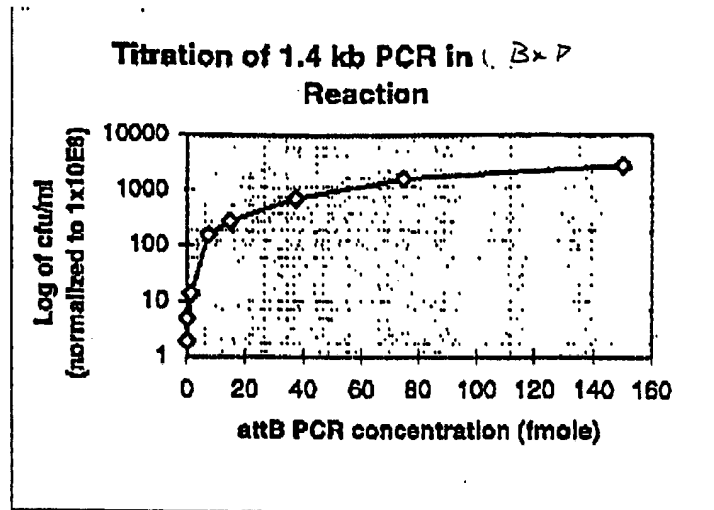
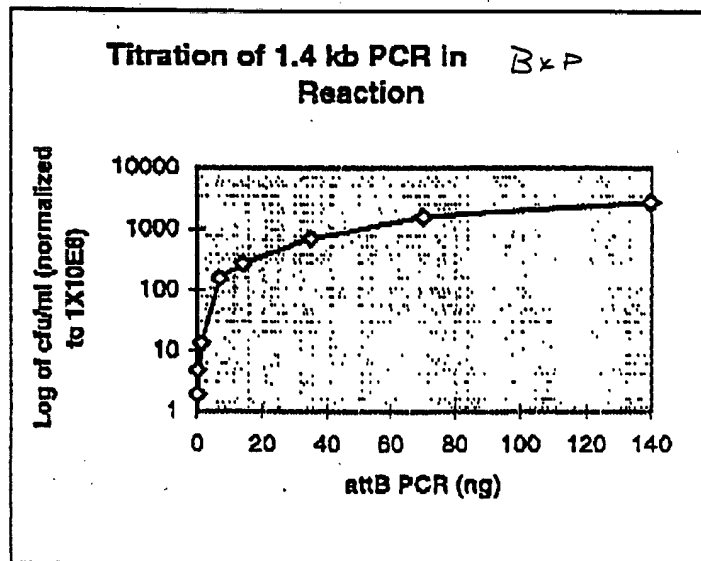


FIGURE 71

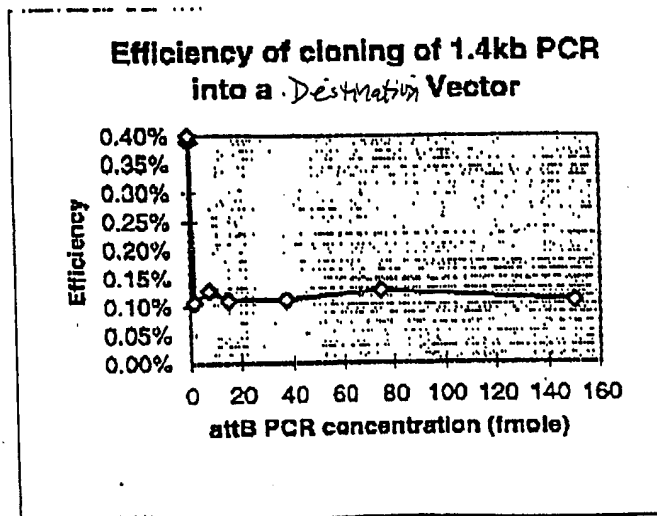
A



B



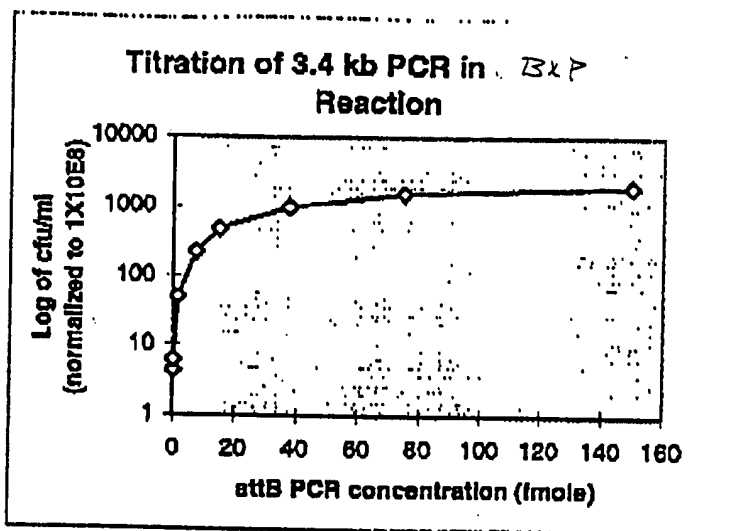
C



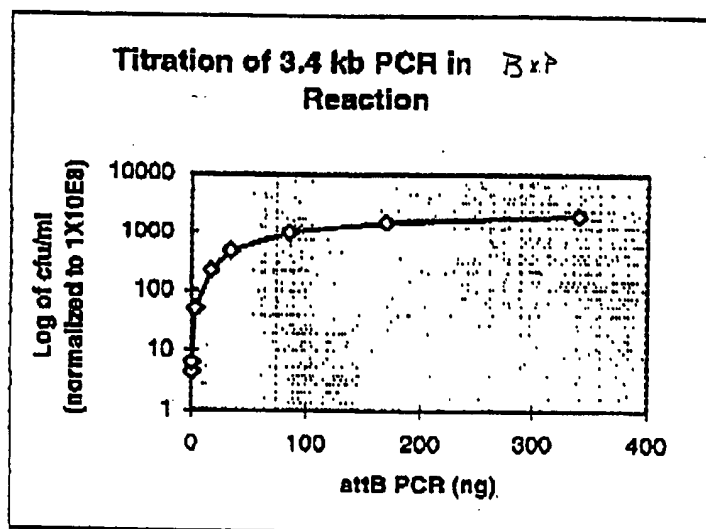
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FIGURE 72

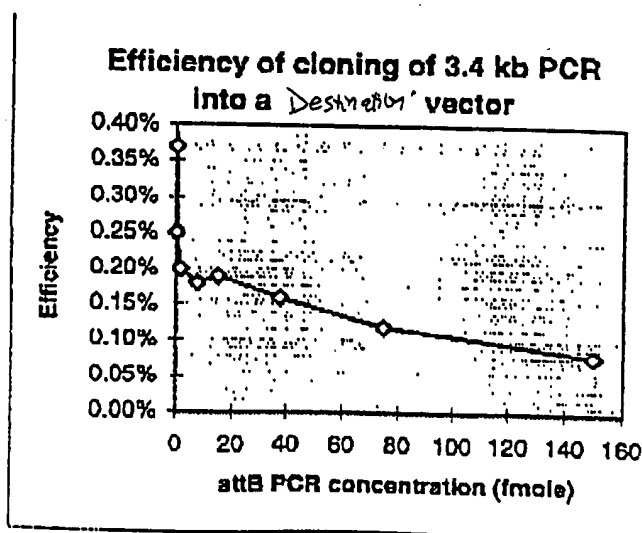
A



B



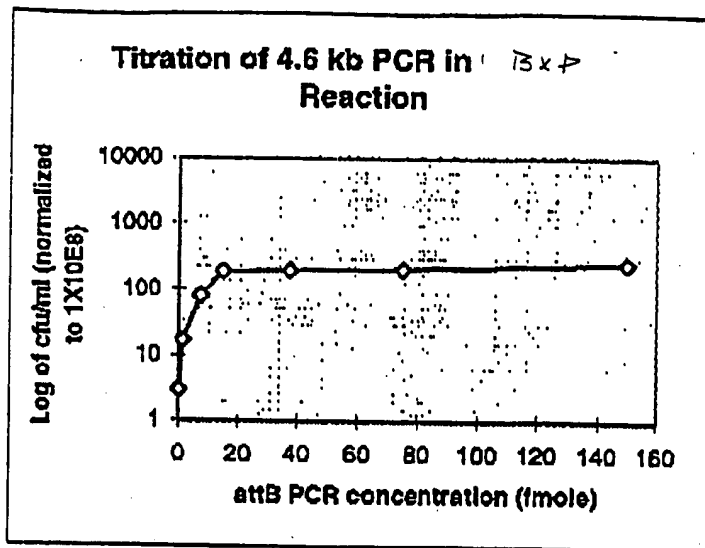
C



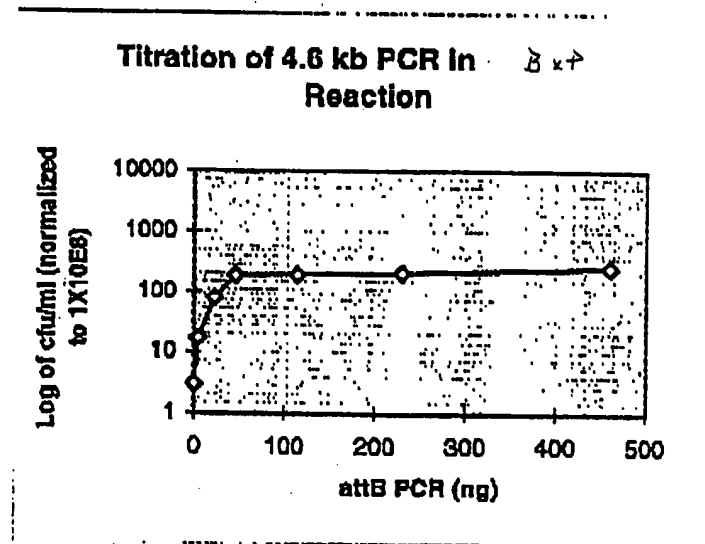
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FIGURE 73

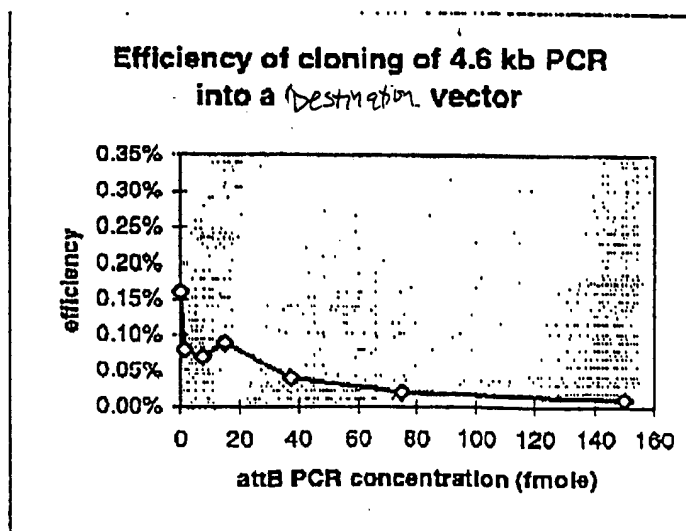
A



B



C



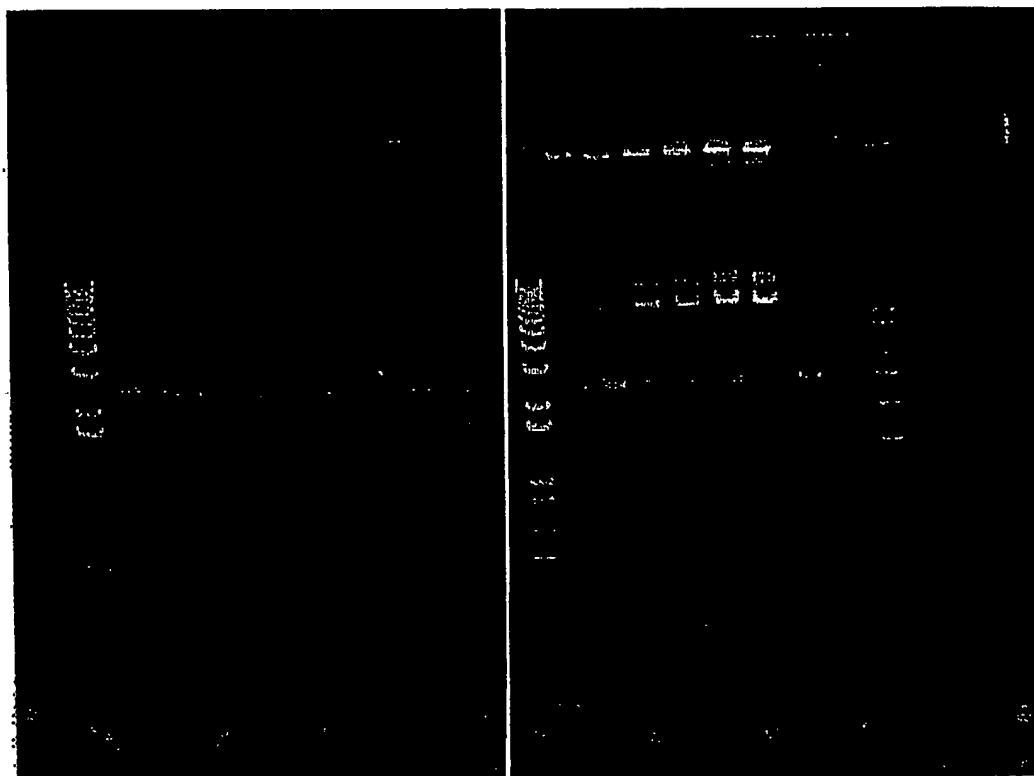
6.9 kb PCR DNA Titration in α BxP Reaction

FIGURE 74

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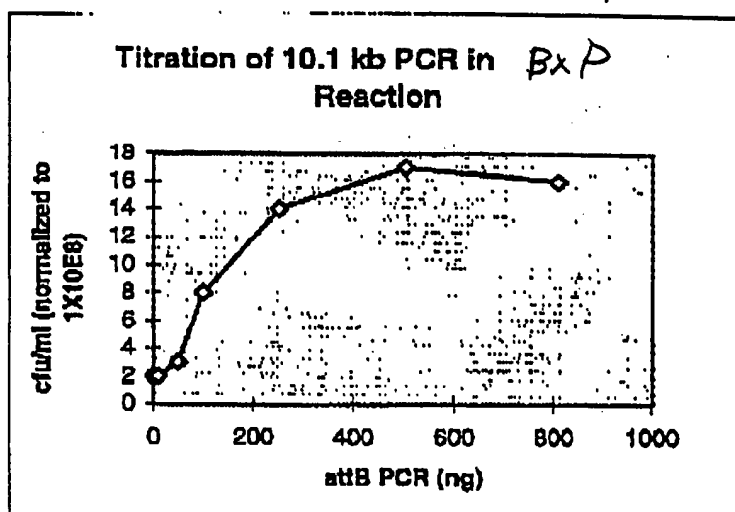


FIGURE 75-

10.1 kb PCR DNA Titration in BxP Reaction

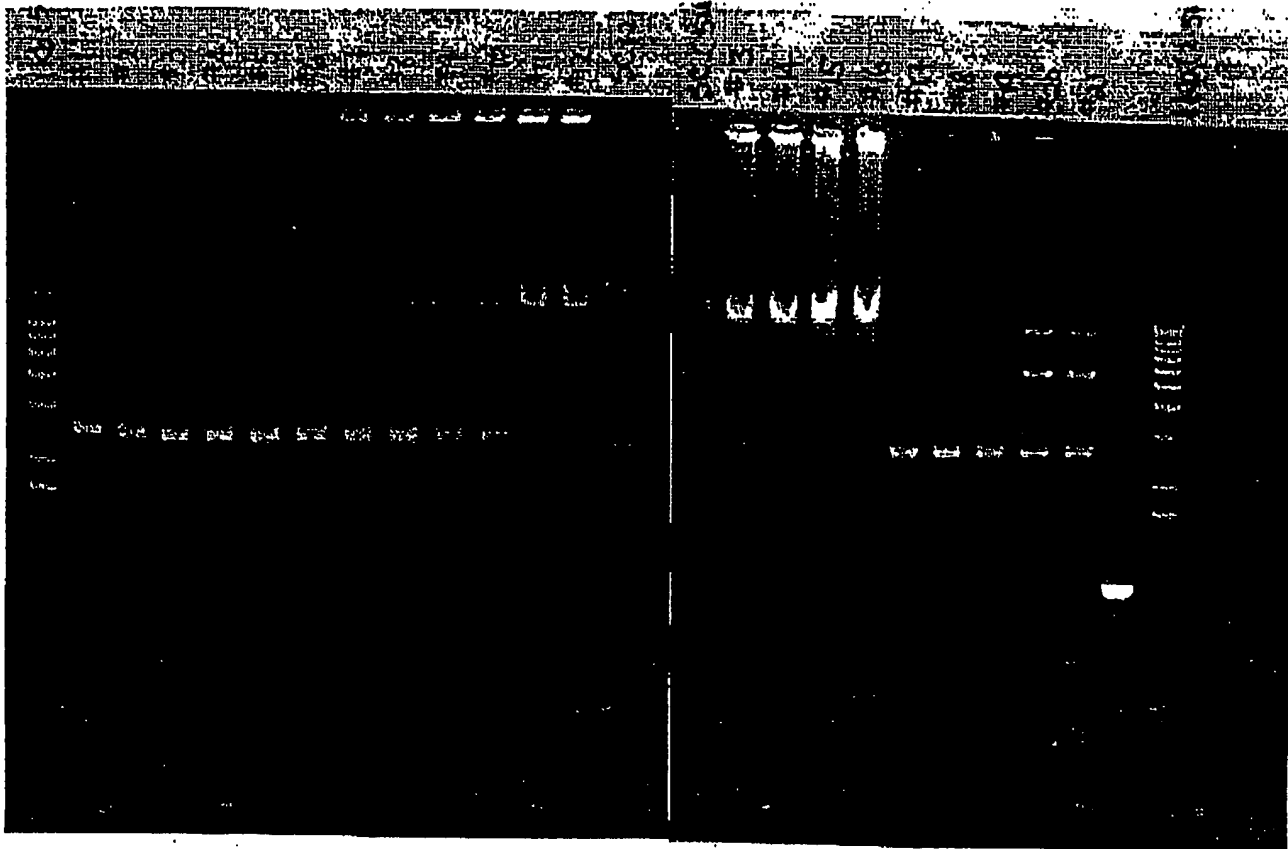


FIGURE 76

Cloning of PCR Products of Different Sizes with the GATEWAY™ PCR Cloning System

Size	fmols PCR DNA	ng PCR DNA	Cols/ml Transformation (pUC=10 ⁸ CFU/ml)	Correct Clones/Total Examined**
0.26 kb*	15 37.5	3 7.5	1223 2815	10/10 (a)
1.0 kb	15 37.5	10 25	507 1447	49/50 (b)
1.4 kb	15 37.5	14 35	271 683	48/50 (c)
3.4 kb	15 37.5	34 85	478 976	9/10 (a)
4.6 kb	15 37.5	46 115	190 195	10/10 (a)
6.9 kb	15 37.5	69 173	30 (235)** 54 (463)**	47/50 (b)

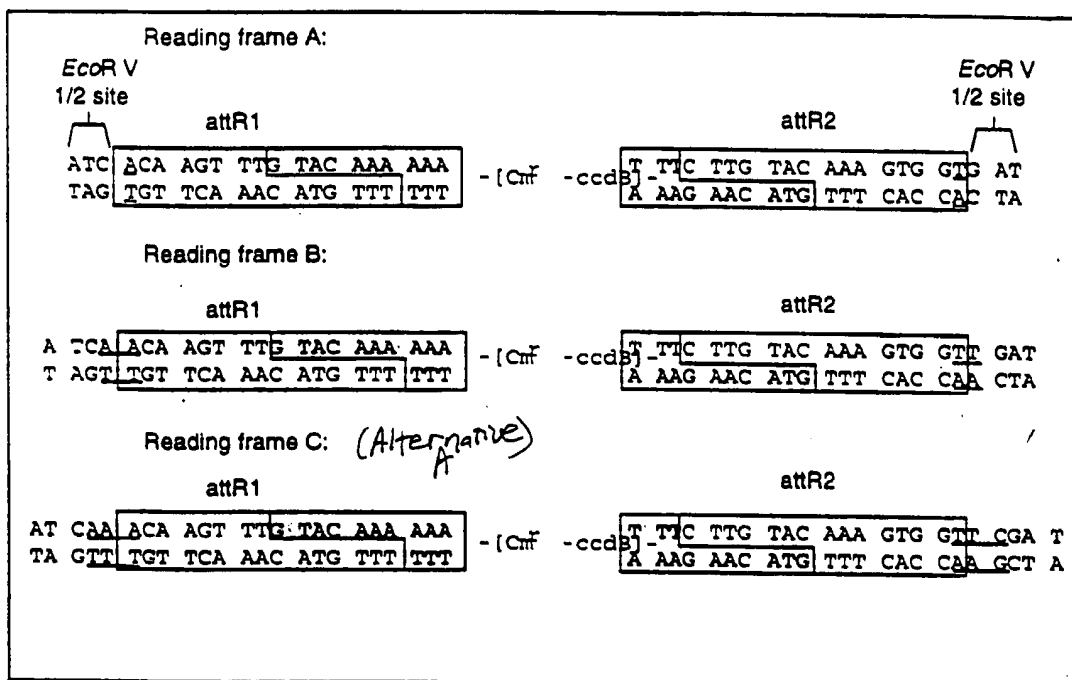
*The 0.26 kb PCR product was used unpurified; all the others were purified by precipitation with PEG/MgCl₂ as described in the text of Example 9, to remove primer dimers potentially present. Standard incubations were for 60 min.

**overnight incubation

- (a) DNA minipreps
- (b) ampR/kanR
- (c) tetR/kanR

Figure 77

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Reading frame C: (Alternative)
B

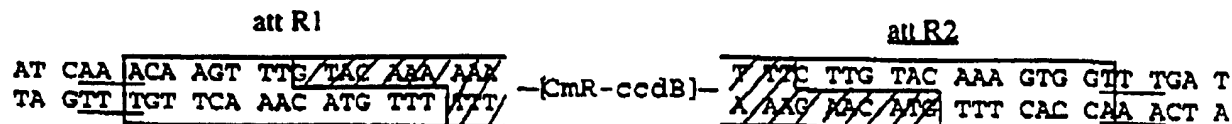


FIGURE 78

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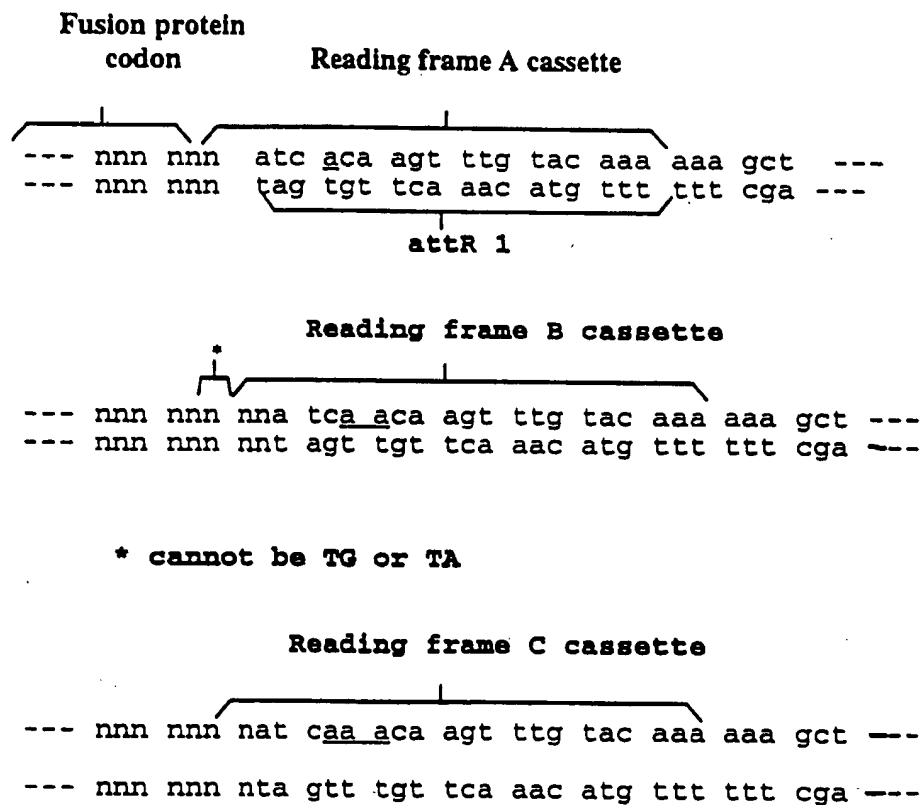
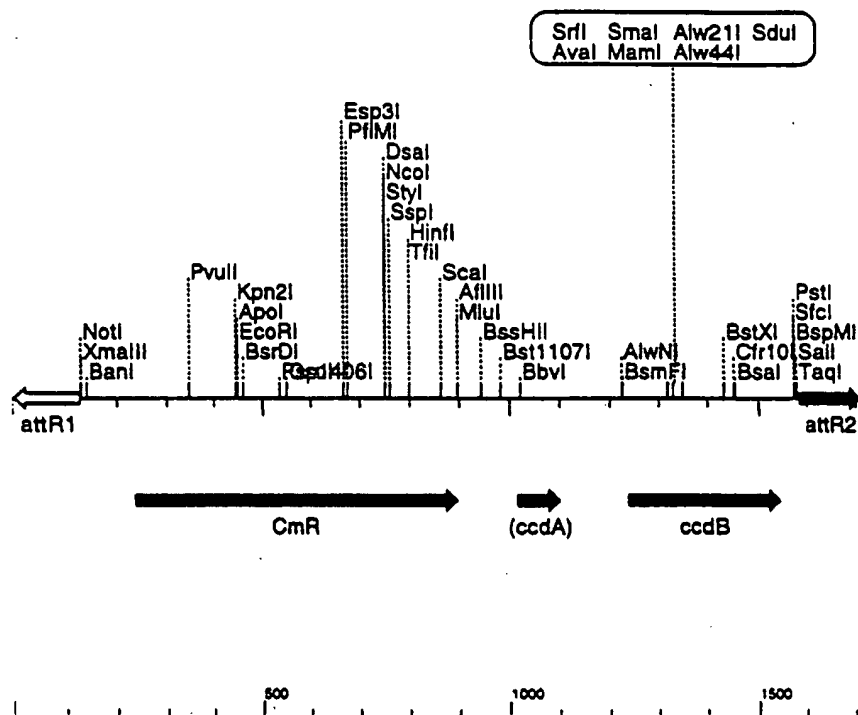


FIGURE 79

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rfa Cassette (1711 bps)

FIGURE 80

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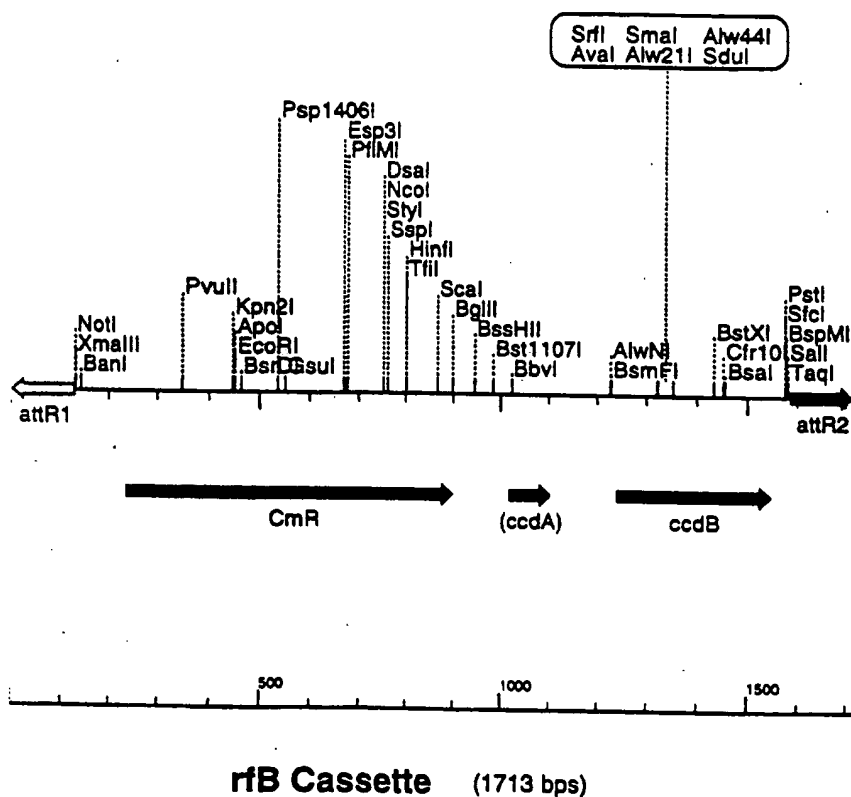
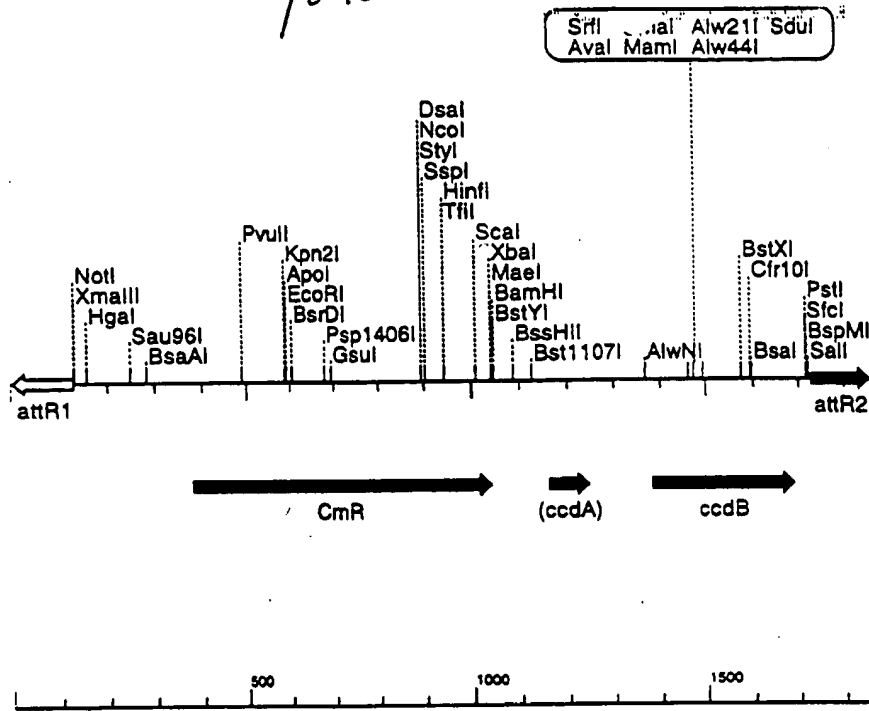


FIGURE 81

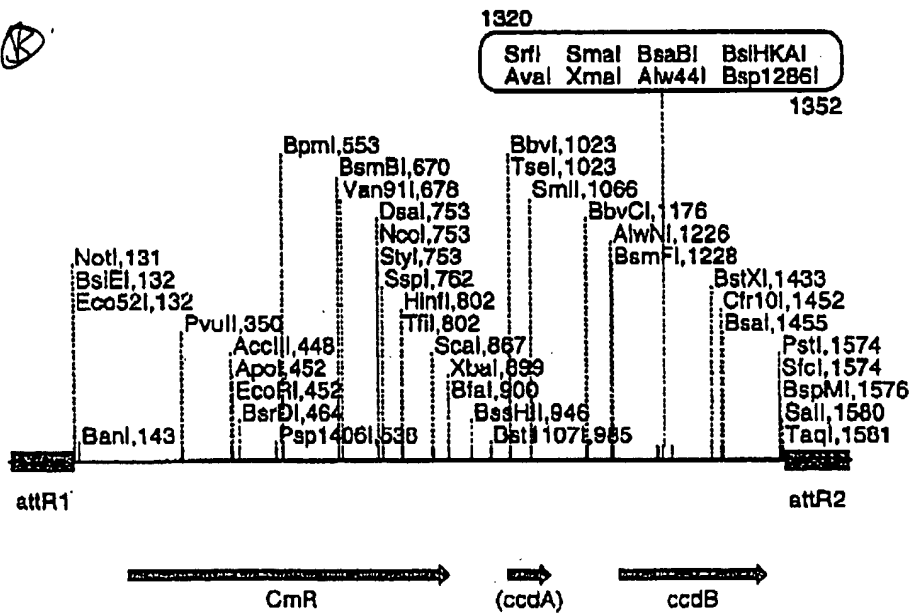
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(A)



rfc Cassette (1856 bps)

(B)



rfc cassette (1715 bps)

FIGURE 82

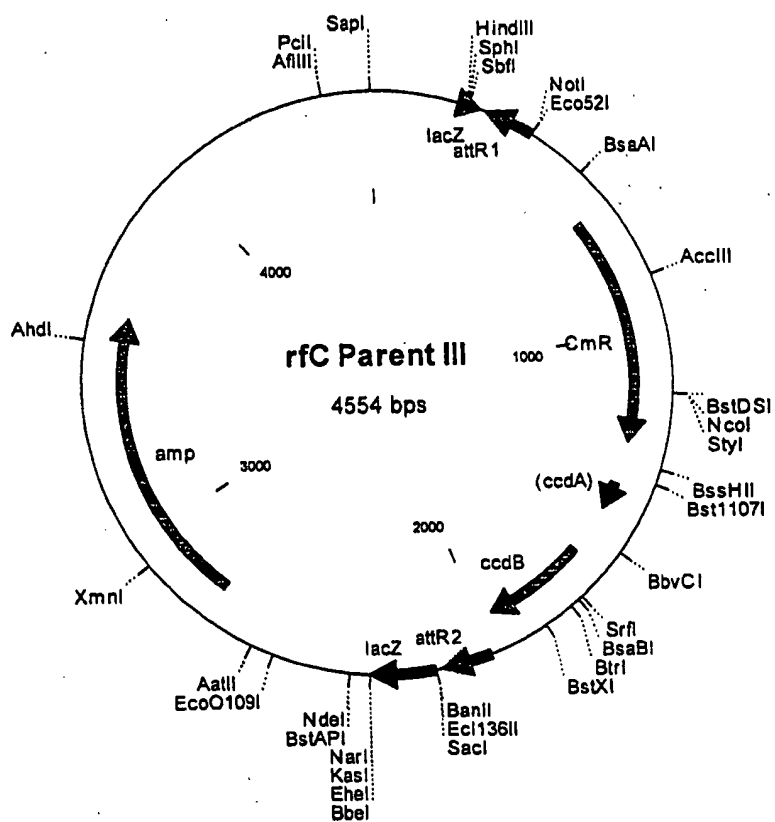


FIGURE 83A

prfC Parent III 4554 bp

<u>Location (Base Nos.)</u>		<u>Gene Encoded</u>
410..286		attR1
660..1319		CmR
1439..1523		inactivated ccdA
1661..1966		ccdB
2007..2131		attR2
2753..3613		amp

1	GCGCCCAATA	CGCAAACCGC	CTCTCCCCGC	GCGTTGGCCG	ATTCATTAAT	GCAGCTGGCA
61	CGACAGGTTT	CCCAGCTGGA	AAGCGGGCAG	TGAGCGCAAC	GCAATTAATG	TGAGTTAGCT
121	CACTCATTAG	GCACCCCAGG	CTTTACACTT	TATGCTTCCG	GCTCGTATGT	TGTGTGGAAT
181	TGTGAGCGGA	TAACAATTTC	ACACAGGAAA	CAGCTATGAC	CATGATTACG	CCAAGCTTGC
241	ATGCCTGCAG	GTCGACTCTA	GAGGATCCCC	GGGTACCGAT	ATCAAACAAG	TTGTGTACAA
301	AAAGCTGAAC	GAGAAACGTA	AAATGATATA	AATATCAATA	TATTAAATTA	GATTTTGCAT
361	AAAAAACAGA	CTACATAATA	CTGTAAAACA	CAACATATCC	AGTCACTATG	GCGGCCGCTA
421	AGTTGGCAGC	ATCACCCGAC	GCACCTTTGCG	CCGAATAAAT	ACCTGTGACG	GAAGATCACT
481	TCGCAGAATA	AATAAATCCT	GGTGTCCCTG	TTGATACCGG	GAAGCCCTGG	GCCAACTTTT
541	GGCGAAAATG	AGACGTTGAT	CGGCACGTAA	GAGGTTCCAA	CTTTCACCAT	AATGAAATAA
601	GATCACTACC	GGGCGTATTT	TTTGAGTTAT	CGAGATTTTC	AGGAGCTAAG	GAAGCTAAAA
661	TGGAGAAAAA	AATCACTGGA	TATACCACCG	TTGATATATC	CCAATGGCAT	CGTAAAGAAC
721	ATTTTGAGGC	ATTTCACTCA	GTTGCTCAAT	GTACCTATAA	CCAGACCGTT	CAGCTGGATA
781	TTACGGCCTT	TTTAAAGACC	GTAAGAAAAA	ATAAGCACAA	GTTTATATCCG	GCCTTTATTC
841	ACATTCTTGC	CCGCCTGATG	AATGCTCATC	CGGAATTCCG	TATGGCAATG	AAAGACGGTG
901	AGCTGGTGAT	ATGGGATAGT	GTTACCCTT	GTTACACCGT	TTTCCATGAG	CAAACGTAAA
961	CGTTTTTCATC	GCTCTGGAGT	GAATACCACG	ACGATTTCCG	GCAGTTTCTA	CACATATATT
1021	CGCAAGATGT	GGCGTGTTAC	GGTGAAAAAC	TGGCCTATTT	CCCTAAAGGG	TTTATTGAGA
1081	ATATGTTTTT	CGTCTCAGCC	AATCCCTGGG	TGAGTTTCAC	CAGTTTGTAT	TTAAACGTGG
1141	CCAATATGGA	CAACTTCTTC	GCCCCCGTTT	TCACCATGGG	CAAATATTAT	ACGCAAGGCG
1201	ACAAGGTGCT	GATGCCGCTG	GCGATTACAG	TTCATCATGC	CGTCTGTGAT	GGCTTCCATG
1261	TCGGCAGAAT	GCTTAATGAA	TTACAACAGT	ACTGCGATGA	GTGGCAGGGC	GGGGCGTAAT
1321	CTAGAGGATC	CGGCTTACTA	AAAGCCAGAT	AACAGTATGC	GTATTTGCGC	GCTGATTTTT
1381	GCGGTATAAG	AATATATACT	GATATGTATA	CCCAGAGTAT	GTCAAAAAGA	GGTGTGCTAT
1441	GAAGCAGCGT	ATTACAGTGA	CAGTTGACAG	CGACAGCTAT	CAGTTGCTCA	AGGCATATAT
1501	GATGTCAATA	TCTCCGGTCT	GGTAAGCACA	ACCATGCAGA	ATGAAGCCCG	TCGTCTGCGT
1561	GCCGAACGCT	GGAAAGCGGA	AAATCAGGAA	GGGATGGCTG	AGGTGCCCCG	GTTTTATTGAA
1621	ATGAACGGCT	CTTTTGCTGA	CGAGAACAGG	GACTGGTGAA	ATGCAGTTTA	AGGTTTACAC
1681	CTATAAAGA	GAGAGCCGTT	ATCGTCTGTT	TGTGGATGTA	CAGAGTGATA	TTATTGCAC
1741	GCCCGGGCGA	CGGATGGTGA	TCCCCCTGGC	CAGTGCACGT	CTGCTGTCAG	ATAAAGTCTC
1801	CCGTGAACCT	TACCCGGTGG	TGCATATCGG	GGATGAAAGC	TGGCGCATGA	TGACCACCGA
1861	TATGGCCAGT	GTGCCGGTCT	CCGTTATCGG	GGAAGAAAGT	GCTGATCTCA	GCCACCGCGA
1921	AAATGACATC	AAAAACGCCA	TTAACCTGAT	GTTCTGGGGA	ATATAAATGT	CAGGCTCCGT
1981	TATACACAGC	CAGTCTGCAG	GTCGACCATA	GTGACTGGAT	ATGTTGTGTT	TTACAGTATT
2041	ATGTAGTCTG	TTTTTTATGC	AAAATCTAAT	TTAATATATT	GATATTTATA	TCATTTTACG
2101	TTTCTCGTTC	AGCTTTCTTG	TACAAAGTGG	TTGATATCG	GTACCGAGCT	CGAATTCAC
2161	GGCCGTCGTT	TTACAACGTC	GTGACTGGGA	AAACCCTGGC	GTTACCCAAC	TTAATCGCCT
2221	TGCAGCACAT	CCCCCTTTCC	CCAGCTGGCG	TAATAGCGAA	GAGGCCCGCA	CCGATCGCCC
2281	TTCCCAACAG	TTGCGCAGCC	TGAATGGCGA	ATGCGCGCTG	ATGCGGTATT	TTCTCCTTAC
2341	GCATCTGTGC	GGTATTTCAC	ACCGCATATG	GTGCACTCTC	AGTACAATCT	GCTCTGATGC
2401	CGCATAGTTA	AGCCAGCCCC	GACACCCGCC	AACACCCGCT	GACGCGCCCT	GACGGGCTTG
2461	TCTGTCCCG	GCATCCGCTT	ACAGACAAGC	TGTGACCGTC	TCCGGGAGCT	GCATGTGTCA
2521	GAGGTTTTCA	CCGTCATCAC	CGAAACGCGC	GAGACGAAAG	GGCCTCGTGA	TACGCTTATT
2581	TTTATAGGTT	AATGTCATGA	TAATAATGGT	TTCTTAGACG	TCAGGTGGCA	CTTTTCGGGG
2641	AAATGTGCGC	GGAACCCCTA	TTTGTATTAT	TTTCTAAATA	CATTCAAATA	TGTATCCGCT
2701	CATGAGACAA	TAACCCTGAT	AAATGCTTCA	ATAATATTGA	AAAAGGAAGA	GTATGAGTAT
2761	TCAACATTTT	CGTGTGCGCC	TTATTCCTTT	TTTTGCGGCA	TTTTGCCTTC	CTGTTTTTGC -

2821 TCACCCAGAA ACGCTGGTGA AAGTAAAAGA TGCTGAAGAT CAGTTGGGTG CACGAGTGGG
2881 TTACATCGAA CTGGATCTCA ACAGCGGTAA GATCCTTGAG AGTTTTCGCC CCGAAGAACG
2941 TTTTCCAATG ATGAGCACTT TTAAAGTTCT GCTATGTGGC GCGGTATTAT CCCGTATTGA
3001 CGCCGGGCAA GAGCAACTCG GTCGCCGCAT ACACTATTCT CAGAATGACT TGGTTGAGTA
3061 CTCACCAGTC ACAGAAAAGC ATCTTACGGA TGGCATGACA GTAAGAGAAT TATGCAGTGC
3121 TGCCATAACC ATGAGTGATA ACACTGCGGC CAACTTACTT CTGACAACGA TCGGAGGACC
3181 GAAGGAGCTA ACCGCTTTTT TGCACAACAT GGGGGATCAT GTAACTCGCC TTGATCGTTG
3241 GGAACCGGAG CTGAATGAAG CCATACCAA CGACGAGCGT GACACCACGA TGCCTGTAGC
3301 AATGGCAACA ACGTTGCACA AACTATTAAC TGGCGAACTA CTTACTCTAG CTTCCCGGCA
3361 ACAATTAATA GACTGGATGG AGGCGGATAA AGTTGCAGGA CCACTTCTGC GCTCGGCCCT
3421 TCCGGCTGGC TGGTTTATTG CTGATAAATC TGGAGCCGGT GAGCGTGGGT CTCGCGGTAT
3481 CATTGCAGCA CTGGGGCCAG ATGGTAAGCC CTCCCGTATC GTAGTTATCT ACACGACGGG
3541 GAGTCAGGCA ACTATGGATG AACGAAATAG ACAGATCGCT GAGATAGGTG CCTCACTGAT
3601 TAAGCATTGG TAACTGTCAG ACCAAGTTTA CTCATATATA CTTTAGATTG ATTTAAAAC
3661 TCATTTTAA TTTAAAAGGA TCTAGGTGAA GATCCTTTTT GATAATCTCA TGACCAAAAT
3721 CCCTTAACGT GAGTTTTCGT TCCACTGAGC GTCAGACCCC GTAGAAAAGA TCAAAGGATC
3781 TTCTTGAGAT CCTTTTTTTC TGCGCGTAAT CTGCTGCTTG CAAACAAAAA AACCACCGCT
3841 ACCAGCGGTG GTTTGTTTGC CGGATCAAGA GCTACCAACT CTTTTTCCGA AGGTAACCTG
3901 CTTCAGCAGA GCGCAGATAC CAAATACTGT CCTTCTAGTG TAGCCGTAGT TAGGCCACCA
3961 CTTCAAGAAC TCTGTAGCAC CGCCTACATA CCTCGCTCTG CTAATCCTGT TACCAGTGGC
4021 TGCTGCCAGT GGCGATAAGT CGTGTCTTAC CGGGTTGGAC TCAAGACGAT AGTTACCGGA
4081 TAAGGCGCAG CGGTCGGGCT GAACGGGGGG TTCGTGCACA CAGCCCAGCT TGGAGCGAAC
4141 GACCTACACC GAACTGAGAT ACCTACAGCG TGAGCTATGA GAAAGCGCCA CGCTTCCCGA
4201 AGGGAGAAAG GCGGACAGGT ATCCGGTAAG CGGCAGGGTC GGAACAGGAG AGCGCACGAG
4261 GGAGCTTCCA GGGGGAACG CCTGGTATCT TTATAGTCCT GTCGGGTTTC GCCACCTCTG
4321 ACTTGAGCGT CGATTTTGT GATGCTCGTC AGGGGGGCGG AGCCTATGGA AAAACGCCAG
4381 CAACGCGGCC TTTTACGGT TCCTGGCCTT TTGCTGGCCT TTTGCTCACA TGTTCTTTCC
4441 TCGGTTATCC CCTGATTCTG TGGATAACCG TATTACCGCC TTTGAGTGAG CTGATACCGC
4501 TCGCCGCAGC CGAACGACCG AGCGCAGCGA GTCAGTGAGC GAGGAAGCGG AAGA

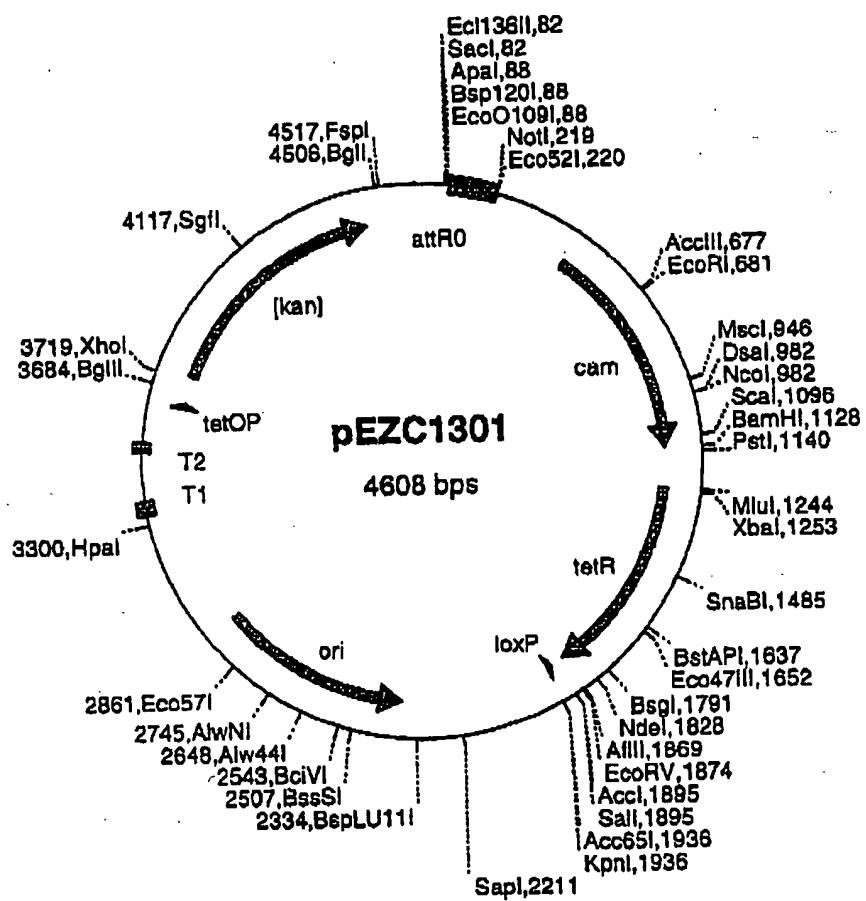


FIGURE 84

196/240

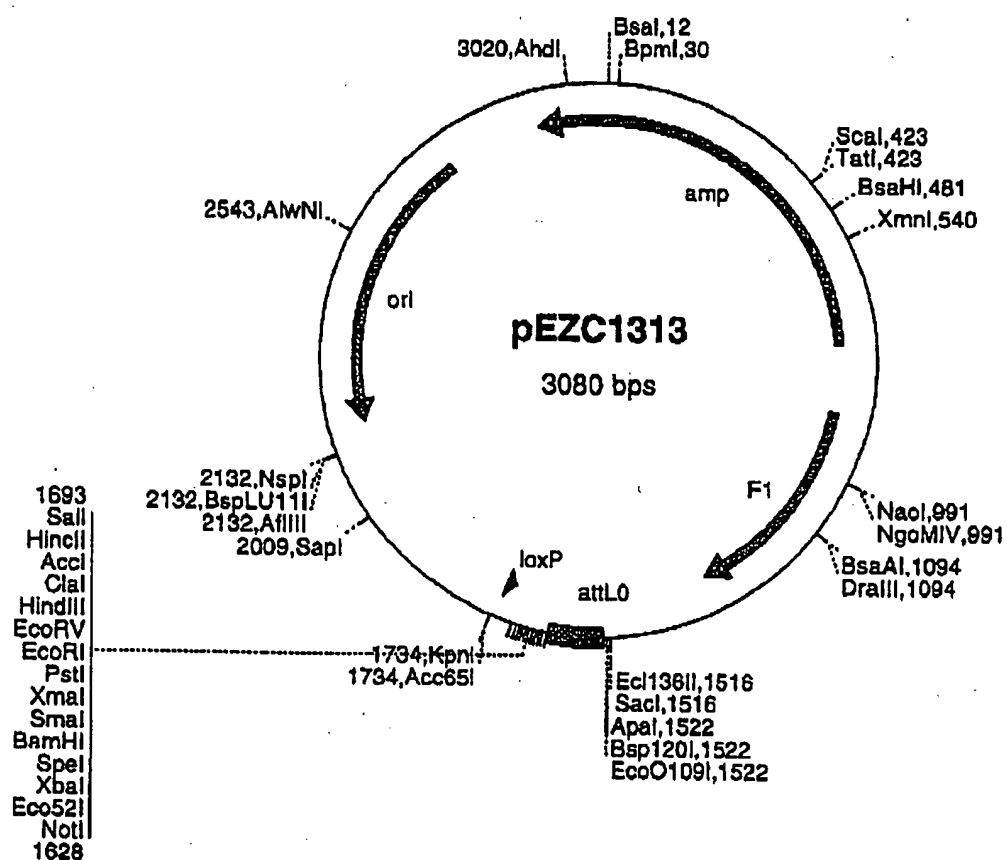


FIGURE 85

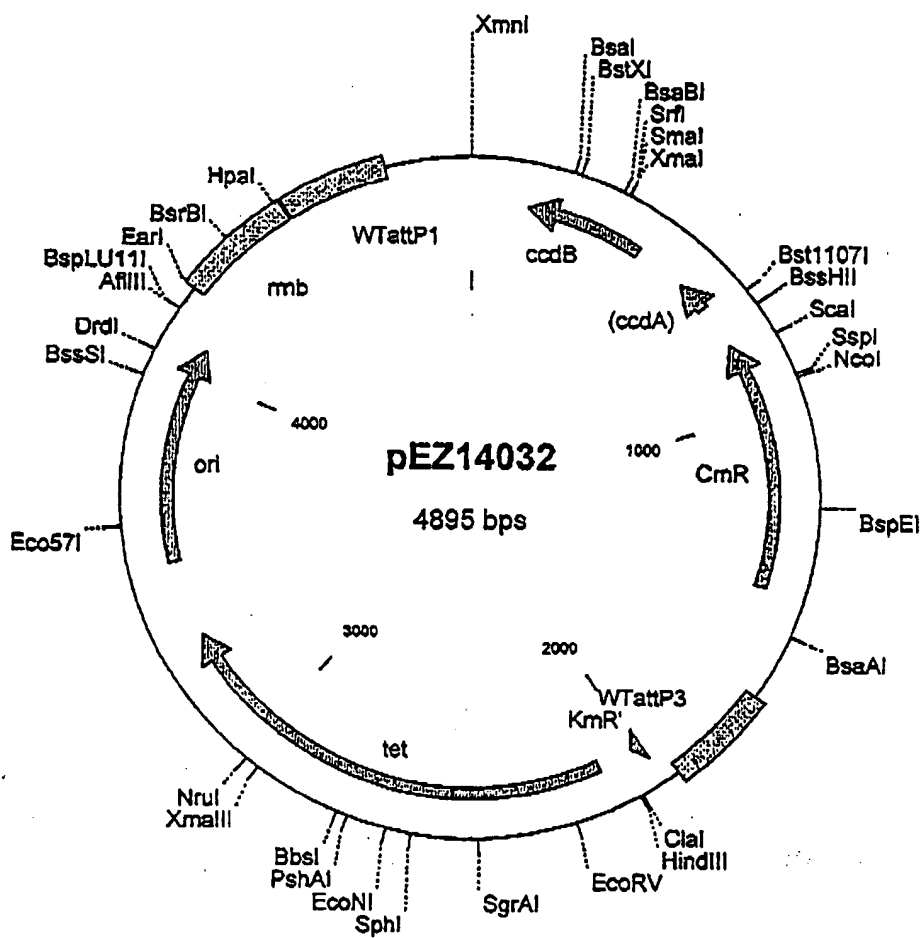


FIGURE 86

FIGURE 87

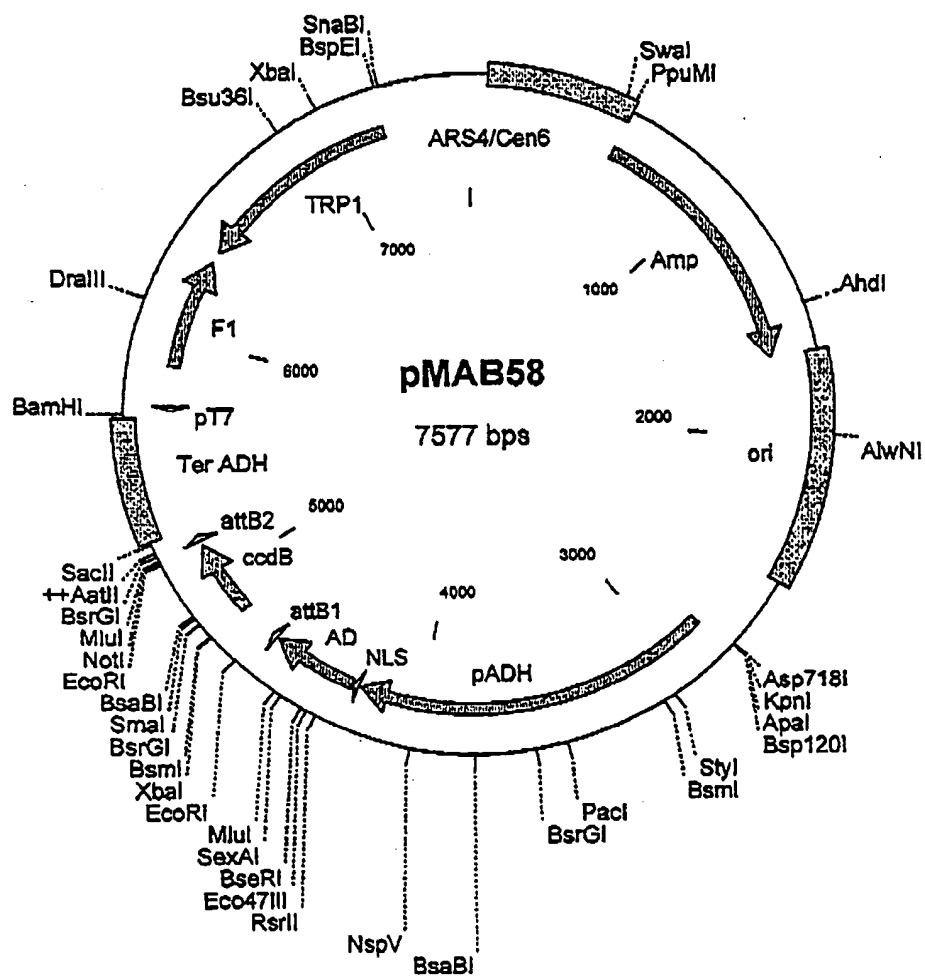
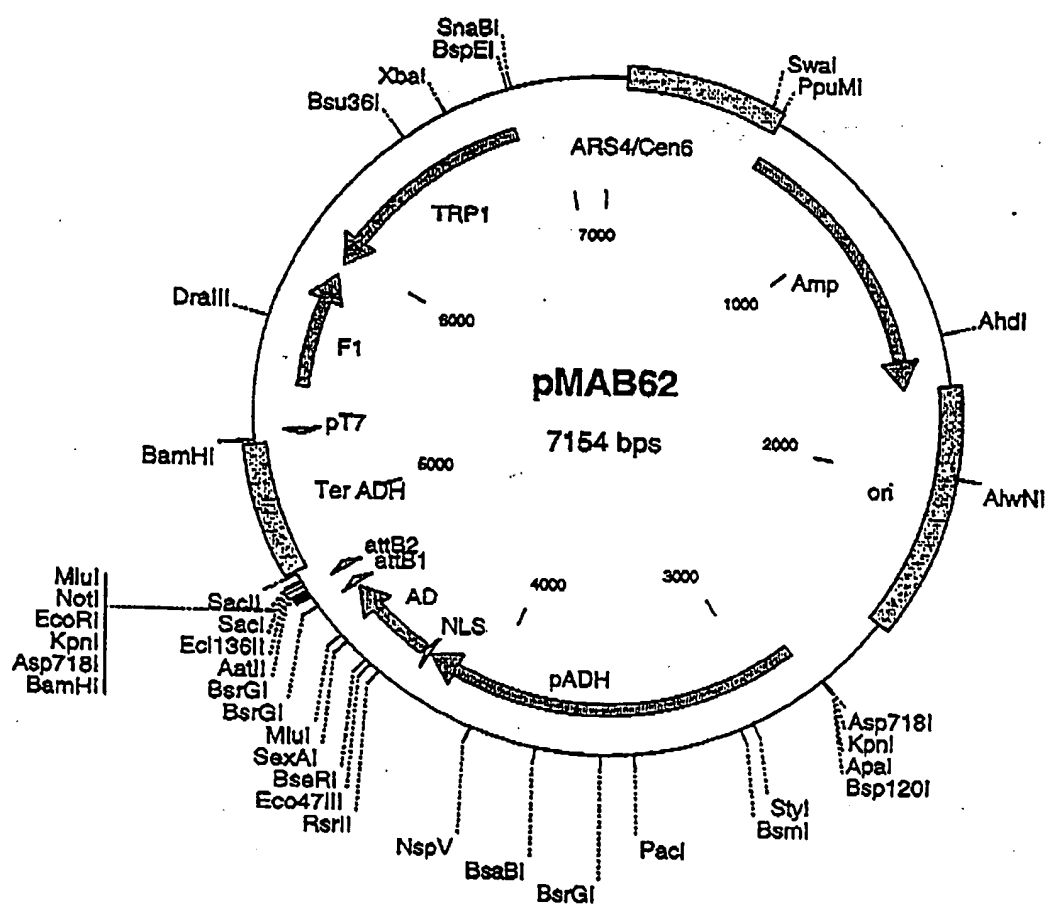
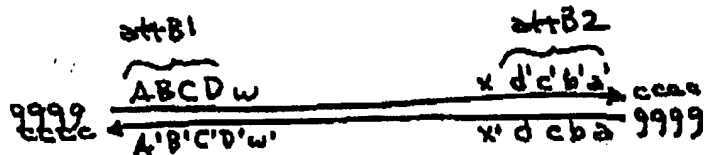
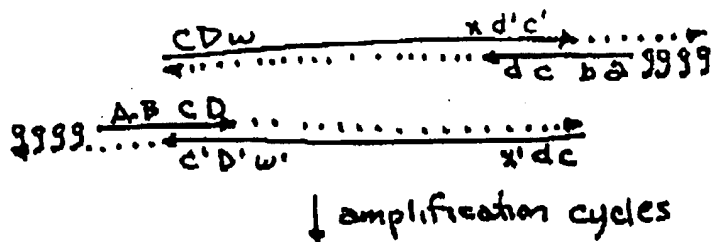
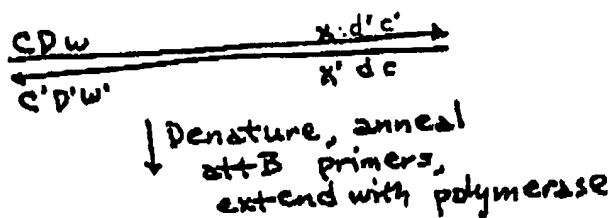
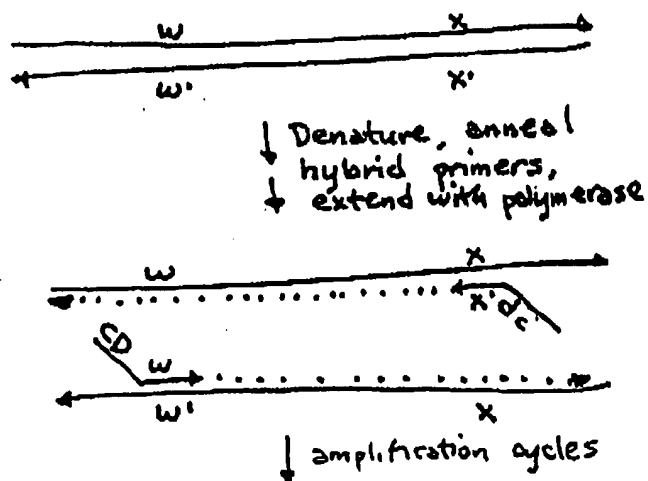


FIGURE 88



DNA to be amplified (5' → 3'):



attB1 primer:
9999 ABCD

attB2 primer:
9999 abca

Hybrid primers (part
attB, part gene
specific):

CDw
cd x'

FIGURE 89

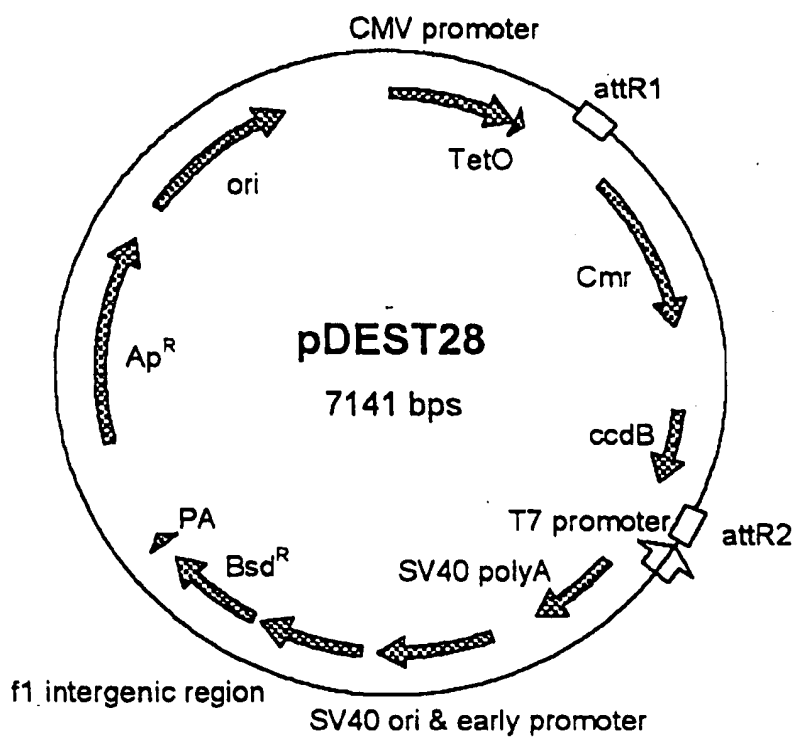


FIGURE 90A

pDEST28 7141 bp

ATGCATGTCGTTACATAA CTTACGGTAAATGGCCCCGCTGGCTGACCGCCCAACGACCCC
CGCCCATTTGACGTCAATAATGACGTATGTTCCCATAGTAACGCCAATAGGGACTTTCCAT
TGACGTCAATGGGTGGAGTATTTACGGTAAACTGCCCACTTGGCAGTACATCAAGTGTAT
CATATGCCAAGTACGCCCCCTATTGACGTCAATGACGGTAAATGGCCCCGCTGGCATTAT
GCCCAGTACATGACCTTATGGGACTTTCTACTTGGCAGTACATCTACGTATTAGTCATC
GCTATTACCATGGTGATGCGGTTTTGGCAGTACATCAATGGGCGTGGATAGCGGTTTTGAC
TCACGGGGATTTCCAAGTCTCCACCCCATTGACGTCAATGGGAGTTTTGTTTTGGCACCAA
AATCAACGGGACTTTCCAAAATGTCGTAACAACCTCCGCCCCATTGACGCAAATGGGCGGT
AGGCGTGACGGTGGGAGGTCTATATAAGCAGAGCTCTCCCTATCAGTGATAGAGATCTC
CCTATCAGTGATAGAGATCGTCGACGAGCTCGTTTTAGTGAACCGTCAGATCGCCTGGAGA
CGCCATCCACGCTGTTTTGACCTCCATAGAAGACACCGGGACCGATCCAGCCTCCGGACT
CTAGAGGATCCCTACCGGTGATATCCTCGAGCCCATCAACAAGTTTTGTACAAAAAAGCTG
AACGAGAAACGTAAATGATATAAATATCAATATATTAAATTAGATTTTGCATAAAAAAC
AGACTACATAAATACTGTAAAACACAACATATCCAGTCACTATGGCGGCCGCATTAGGCAC
CCCAGGCTTTACACTTTATGCTTCCGGCTCGTATAATGTGTGGATTTTGAGTTAGGATCC
GGCGAGATTTTCAGGAGCTAAGGAAGCTAAAATGGAGAAAAAATCACTGGATATACCAC
CGTTGATATATCCCAATGGCATCGTAAAGAACATTTTGAGGCATTTTCAGTCAGTTGCTCA
ATGTACCTATAACCAGACCGTTCAGCTGGATATTACGGCCTTTTTTAAAGACCGTAAAGAA
AAATAAGCACAAGTTTTATCCGGCCTTTATTCACATTCTTGCCCGCCTGATGAATGCTCA
TCCGGAATTCGGTATGGCAATGAAAGACGGTGAGCTGGTGATATGGGATAGTGTTACCCC
TTGTTACACCGTTTTCCATGAGCAAACCTGAAACGTTTTTCATCGCTCTGGAGTGAATACCA
CGACGATTTCCGGCAGTTTTCTACACATATATTGCAAGATGTGGCGTGTTACGGTGAAAA
CCTGGCCTATTTCCCTAAAGGGTTTTATTGAAATATGTTTTTTCGTCTCAGCCAATCCCTG
GGTGAGTTTTCAACGTTTTGATTTAAACGTGGCCAATATGGACAACCTTCTTCGCCCCCGT
TTTCACCATGGGCAATATTATACGCAAGGCGACAAGGTGCTGATGCCGCTGGCGATTCA
GGTTCATCATGCCGTCTGTGATGGCTTCCATGTCCGCAGAATGCTTAATGAATTACAACA
GTACTGCGATGAGTGGCAGGGCGGGCGTAAAGATCTGGATCCGGCTTACTAAAAGCCAG
ATAACAGTATGCGTATTTGCGCGCTGATTTTTGCGGTATAAGAATATATACTGATATGTA
TACCCGAAGTATGTCAAAAAGAGGTGTGCTATGAAGCAGCGTATTACAGTGACAGTTGAC
AGCGACAGCTATCAGTTGCTCAAGGCATATATGATGTCAATATCTCCGGTCTGGTAAGCA
CAACCATTCAGAAATGAAGCCCGTCTGCTGCGTCCGAACGCTGGAAAGCGGAAATCAGG
AAGGGATGGCTGAGGTGCGCCCGTTTTATTGAAATGAACGGCTCTTTTGCTGACGAGAACA
GGGACTGGTGAAATGCAGTTTAAGGTTTACACCTATAAAAAGAGAGAGCCGTTATCGTCTG
TTTGTGGATGTACAGAGTGATATTATTGACACGCCCCGGGCGACGGATGGTGATCCCCCTG
GCCAGTGACAGTCTGCTGTCAGATAAAGTCTCCCGTGAACTTTACCCGGTGGTGATATC
GGGGATGAAAGCTGGCGCATGATGACCACCGATATGGCCAGTGTGCCGGTCTCCGTTATC
GGGGAAGAAGTGGCTGATCTCAGCCACCGCGAAAATGACATCAAAAACGCCATTAACTG
ATGTTCTGGGGAATATAAATGTCAGGCTCCCTTATACACAGCCAGTCTGCAGGTCGACCA
TAGTGACTGGATATGTTGTGTTTTACAGTATTATGTAGTCTGTTTTTTATGCAAAATCTA
ATTTAATATATTGATATTTATATCATTTTACGTTTCTCGTTCAGCTTTCTTGTACAAAGT
GGTTGATGGGCGGCCGCTCTAGAGGGCCCACTTACGCGTGATGCGACGTCATAGCTC
TCTCCCTATAGTGAGTTCGTATTATAAGCTAGGCACTGGCCGTCGTTTTACAACGTCGTGA
CTGGGAAAACCTGCTAGCTTGGGATCTTTGTGAAGGAACCTTACTTCTGTGGTGTGACATA
ATTGGACAAACTACCTACAGAGATTTAAAGCTCTAAGGTAAATATAAAATTTTTAAGTGT
ATAATGTGTTAAACTAGCTGCATATGCTTGCTGCTTGAGAGTTTTGCTTACTGAGTATGA
TTTATGAAAATATTATACACAGGAGCTAGTGATTCTAATTGTTTGTGATTTTAGATTCA
CAGTCCCAAGGCTCATTTCAGGCCCCCTCAGTCCTCACAGTCTGTTTCATGATCATAATCAG
CCATACCACATTTGTAGAGGTTTTACTTGCTTTAAAAAACCTCCCACACCTCCCCCTGAA
CCTGAAACATAAAATGAATGCAATTGTTGTTGTTAACTTGTTTATTGCAGCTTATAATGG
TTACAAAATAAAGCAATAGCATCAAAATTTACAAAATAAAGCAATTTTTTTTCACTGCATTC
TAGTTGTGTTTTGTCCAAACTCATCAATGTATCTTATCATGTCTGGATCGATCCTGCATT
AATGAATCGGCCAACGCGCGGGGAGAGGCGGTTTTGCGTATTGGCTGGCGTAATAGCGAAG
AGGCCCCGACCGATCGCCCTTCCCAACAGTTGCGCAGCCTGAATGGCGAATGGGACGCGC
CCTGTAGCGGCGCATTAAGCGCGGCGGTTGTGGTGGTTACGCGCAGCGTGACCGCTACAC
TTGCCAGCGCCCTAGCGCCCGCTCCTTTTCGCTTCTTCCCTTCTTTCTCGCCACGTTTCG
CCGGCTTTCCCCGTCAAGCTCTAAATCGGGGGCTCCCTTTAGGGTTCCGATTTAGTGCTT-

FIGURE 90B

TACGGCACCTCGACCCCAAAAACTTGATTAGGGTGATGGTTACGCTAGTGGGCCATCGC
CCTGATAGACGGTTTTTCGCCCTTTGACGTTGGAGTCCACGTTCTTTAATAGTGGACTCT
TGTTCCAAACTGGAACAACACTCAACCCTATCTCGGTCTATTCTTTTGATTATAAGGGA
TTTTGCCGATTTTCGGCCTATTGGTTAAAAAATGAGCTGATTTAACAAATATTTAACGCGA
ATTTTAACAAAATATTAACGTTTACAATTTTCGCTGATGCGGTATTTTCTCCTTACGCAT
CTGTGCGGTATTTTCACACCCGCATACGCGGATCTGCGCAGCACCATGGCCTGAAATAACCT
CTGAAAGAGGAACCTTGGTTAGGTACCTTCTGAGGCGGAAAGAACCAGCTGTGGAATGTGT
GTCAGTTAGGGTGTGGAAAGTCCCCAGGCTCCCCAGCAGGCAGAAGTATGCAAAGCATGC
ATCTCAATTAGTCAGCAACCAGGTGTGGAAAGTCCCCAGGCTCCCCAGCAGGCAGAAGTA
TGCAAAGCATGCATCTCAATTAGTCAGCAACCATAGTCCCGCCCCCTAACTCCGCCCCATCC
CGCCCCCTAACTCCGCCCCAGTTCCGCCCCATTCTCCGCCCCATGGCTGACTAATTTTTTTTA
TTTATGCAGAGGCCGAGGCCGCTCGGCCTCTGAGCTATTCCAGAAGTAGTGAGGAGGCT
TTTTTGGAGGCCCTAGGCTTTTTGCAAAAAGCTTGATTCTTCTGACACAACAGTCTCGAACT
TAAGACCATTGGCCAAGCCTTTGTCTCAAGAAGAATCCACCCTCATTGAAAGAGCAACGGC
TACAATCAACAGCATCCCCATCTCTGAAGACTACAGCGTCGCCAGCGCAGCTCTCTCTAG
CGACGGCCGCATCTTCACTGGTGTCAATGTATATCATTTTTACTGGGGGACCTTGTGCAGA
ACTCGTGGTGTCTGGGCACTGCTGCTGCTGCGGCAGCTGGCAACCTGACTTGTATCGTCGC
GATCGGAAATGAGAACAGGGGCATCTTGAGCCCCCTGCGGACGGTGCCGACAGGTGCTTCT
CGATCTGCATCCTGGGATCAAAGCCATAGTGAAGGACAGTGATGGACAGCCGACGGCAGT
TGGGATTCGTGAATTGCTGCCCTCTGGTTATGTGTGGGAGGGCTAAGCACTTCGTGGCCG
AGTTTCGAAATGACCGACCAAGCGACGCCCAACCTGCCATCACGATGGCCGCAATAAAATA
TCTTTATTTTTCATTACATCTGTGTGTTGGTTTTTTGTGTGAATCGATAGCGATAAGGATC
CGCGTATGGTGCATCTCTAGTACAATCTGCTCTGATGCCGCATAGTTAAGCCAGCCCCGA
CACCCGCCAACACCCGCTGACGCGCCCTGACGGGCTTGTCTGCTCCCGGCATCCGCTTAC
AGACAAGCTGTGACCGTCTCCGGGAGCTGCATGTGTGAGAGGTTTTACCGTCATCACCG
AAACGCGCGAGACGAAAGGGCCTCGTGATACGCCTATTTTTTATAGGTTAATGTCATGATA
ATAATGGTTTTCTTAGACGTGAGGTGGCACTTTTCGGGGAAATGTGCGCGGAACCCCTATT
TGTTTTATTTTTCTAAATACATTCAAATATGTATCCGCTCATGAGACAATAACCCTGATAA
ATGCTTCAATAATATTGAAAAAGGAAGAGTATGAGTATTCAACATTTCCGTGTCGCCCTT
ATTCCCTTTTTTGCGGCATTTTGCCTTCTGTTTTTTGCTCACCCAGAAACGCTGGTGAAA
GTAAAAGATGCTGAAGATCAGTTGGGTGCACGAGTGGGTTACATCGAACTGGATCTCAAC
AGCGGTAAGATCCTTGAGAGTTTTTCGCCCCGAAGAACGTTTTCCAATGATGAGCACTTTT
AAAGTCTGCTATGTGGCGCGGTATTATCCGTTATTGACGCCGGGCAAGAGCAACTCGGT
CGCCGCATACATATTCTCAGAATGACTTGGTTGAGTACTCACCAGTACAGAAAAGCAT
CTTACGGATGGCATGACAGTAAGAGAATTATGCAGTGCTGCCATAACCATGAGTGATAAC
ACTGCGGCCAACTTACTTCTGACAACGATCGGAGGACCGAAGGAGCTAACCGCTTTTTTG
CACAACATGGGGGATCATGTAACCTCGCCTTGATCGTTGGGAACCGGAGCTGAATGAAGCC
ATACCAAACGACGAGCGTGACACCACGATGCCTGTAGCAATGGCAACAACGTTGCGCAAA
CTATTAACCTGGCGAACTACTTACTCTAGCTTCCCGGCAACAATTAATAGACTGGATGGAG
GCGGATAAAGTTGCAGGACCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTTATTGCT
GATAAATCTGGAGCCGGTGAGCGTGGGTCTCGCGGTATCATTTGCAGCACTGGGGCCAGAT
GGTAAGCCCTCCCGTATCGTAGTTATCTACACGACGGGGAGTCAGGCAACTATGGATGAA
CGAAATAGACAGATCGCTGAGATAGGTGCCTCACTGATTAAAGCATTGGTAAGTGTGAGAC
CAAGTTTACTCATATATACTTTAGATTGATTTAAAACTTCATTTTTTAATTTAAAGGATC
TAGGTGAAGATCCTTTTTTGATAATCTCATGACCAAAATCCCTTAACGTGAGTTTTTCGTTT
CACTGAGCGTCAGACCCCGTAGAAAAGATCAAAGGATCTTCTTGAGATCCTTTTTTTCTG
CGCGTAATCTGCTGCTTGCAAACAAAAAAACCACCGCTACCAGCGGTGGTTTTGTTGCGG
GATCAAGAGCTACCAACTCTTTTTCCGAAGGTAACCTGGCTTCAGCAGAGCGCAGATACCA
AATACTGTCTTCTAGTGTAGCCGTAGTTAGGCCACCACTTCAAGAACTCTGTAGCACCG
CCTACATACCTCGCTCTGCTAATCCTGTTACCAGTGGCTGCTGCCAGTGGCGATAAGTCG
TGTCTTACCGGGTTGGACTCAAGACGATAGTTACCGGATAAGGCGCAGCGGTGGGCTGA
ACGGGGGTTCTGTGCACACAGCCAGCTTGGAGCGAACGACCTACACCGAACTGAGATAC
CTACAGCGTGAGCATTGAGAAAGCGCCACGCTTCCCGAAGGGAGAAAGGCGGACAGGTAT
CCGGTAAGCGGCAGGGTCCGAACAGGAGAGCGCACGAGGGAGCTTCCAGGGGGAACCGCC
TGGTATCTTTATAGTCCTGTGCGGTTTTCGCCACCTCTGACTTGAGCGTCGATTTTTGTGA
TGCTCGTCAGGGGGGCGGAGCCTATGGA AAAACGCCAGCAACGCGGCCTTTTTACGGTTC
CTGGCCTTTTTGCTGGCCTTTTTGCTCACATGTTCTTCTGCGTTATCCCCTGATTCTGTG
GATAACCGTATTACCGCCTTTGAGTGAGCTGATACCGCTCGCCGACGCCGAACGACCGAG-

FIGURE 90C

CGCAGCGAGTCAGTGAGCGAGGAAGCGGAAGAGCGCCCAATACGCAAACCGCCTCTCCCC
GCGCGTTGGCCGATTCATTAATGCAGAGCTTGCAATTCGCGCGTTTTTCAATATTATTGA
AGCATTATCAGGGTTATTGTCTCATGAGCGGATACATATTTGAATGTATTTAGAAAAAT
AAACAAATAGGGGTTCCGCGCACATTTCCCCGAAAAGTGCCACCTGACGTCTAAGAAACC
ATTATTATCATGACATTAACCTATAAAAAATAGGCGTAGTACGAGGCCCTTTCACCTCATTA
G

FIGURE 90D

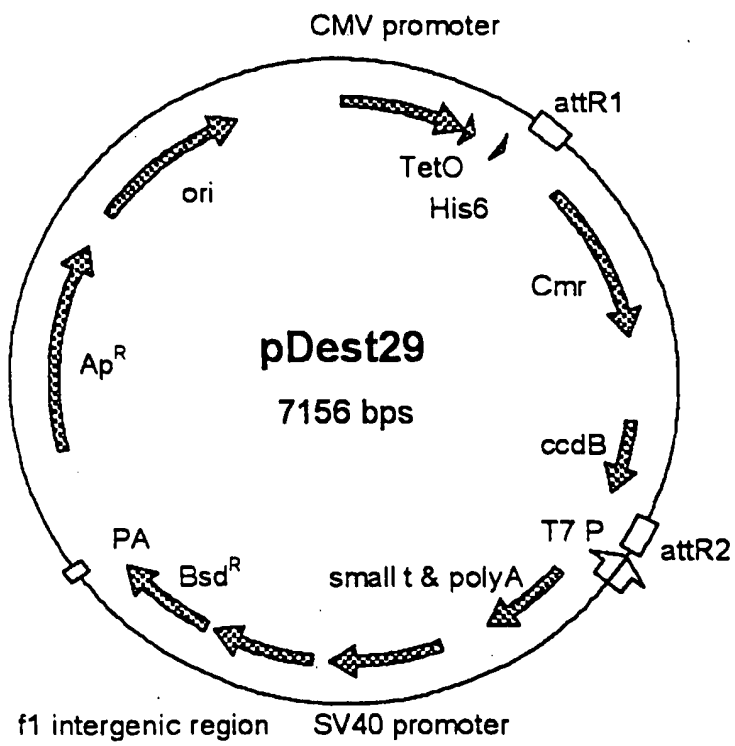


FIGURE 91 A

pDEST29 7156 bp

ATGCATGTCGTTACATAACTTACGGTAAATGGCCCGCCTGGCTGACCGCCCAACGACCCC
CGCCCATTTGACGTCAATAATGACGTATGTTCCCATAGTAACGCCAATAGGGACTTTCCAT
TGACGTCAATGGGTGGAGTATTTACGGTAAACTGCCCACTTGGCAGTACATCAAGTGTAT
CATATGCCAAGTACGCCCCCTATTGACGTCAATGACGGTAAATGGCCCGCCTGGCATTAT
GCCCAGTACATGACCTTATGGGACTTTTCTACTTGGCAGTACATCTACGTATTAGTCATC
GCTATTACCATGGTGATGCGGTTTTTGGCAGTACATCAATGGGCGTGATAGCGGTTTTGAC
TCACGGGGATTTC AAGTCTCCACCCATTGACGTCAATGGGAGTTTTGTTTTGGCACC
AATCAACGGGACTTTCCAAAATGTCGTAACAACCTCCGCCCCATTGACGCAAATGGGCGGT
AGGCGTGATCGGTGGGAGGTCTATATAAGCAGAGCTCTCCCTATCAGTGATAGAGATCTC
CCTATCAGTGATAGAGATCGTCGACGAGCTCGTTTAGTGAACCGTCAGATCGCCTGGAGA
CGCCATCCACGCTGTTTTGACCTCCATAGAAGACACCGGGACCGATCCAGCCTCCGGACC
ATGGCGTACTACCATCACCATCACCATCACACCGGTGATATCCTCGAGCCCATCACAAGT
TTGTACAAAAAGCTGAACGAGAAACGTAAATGATATAAATATCAATATATTAAATTAG
ATTTTGCATAAAAAACAGACTACATAACTGTAAAACACAACATATCCAGTCACTATGG
CGGCCGATTAGGCACCCCAAGGCTTTACACTTTATGCTTCCGGCTCGTATAATGTGTGGA
TTTTGAGTTAGGATCCGGCGAGATTTT CAGGAGCTAAGGAAGCTAAAATGGAGAAAAAA
TCACTGGATATACCACCGTTGATATATCCCAATGGCATCGTAAAGAACATTTTGAGGCAT
TTCAGTCAGTTGCTCAATGTACCTATAACGACCGTTT CAGCTGGATATTACGGCCTTTTT
TAAAGACCGTAAAGAAAAATAAGCACAAGTTTTATCCGGCCTTTATTACATTTCTTCCC
GCCTGATGAATGCTCATCCGGAATTCCGTATGGCAATGAAAGACGGTGAGCTGGTGATAT
GGGATAGTGTTTACCCTTGTTACACCGTTTTTCCATGAGCAAACCTGAAACGTTTTTCATCGC
TCTGGAGTGAATACCACGACGATTTCCGGCAGTTTTCTACACATATATTGCAAGATGTGG
CGTGTTACGGTGAAAACCTGGCCTATTTCCCTAAAGGGTTTTATTGAGAATATGTTTTTCG
TCTCAGCCAATCCCTGGGTGAGTTT CACCAGTTTTGATTTAAACGTGGCCAATATGGACA
ACTTCTTCGCCCCCGTTTTT CACCATGGGCAAATATTATACGCAAGGCGACAAGGTGCTGA
TGCCGCTGGCGATT CAGGTTT CATCATGCCGTCTGTGATGGCTTCCATGTGCGCAGAATGC
TTAATGAATTACAACAGTACTGCGATGAGTGGCAGGCGGGGCGTAAACCGGTGGATCCG
GCTTACTAAAAGCCAGATAACAGTATGCGTATTTGCGCGCTGATTTTTGCGGTATAAGAA
TATATACTGATATGTATATCCGAAGTATGTCAAAGAGGTGTGCTATGAAGCAGCGTAT
TACAGTGACAGTTGACAGCGACAGCTATCAGTTGCTCAAGGCATATATGATGTCAATATC
TCCGGTCTGGTAAGCACAACCATGCAGAATGAAGCCCGTCGTCTGCGTGCCGAACGCTGG
AAAGCGGAAAATCAGGAAGGGATGGCTGAGGTGCGCCGGTTTTATTGAAATGAACGGCTCT
TTTGCTGACGAGAACAGGGACTGGTGAAATGCAGTTTAAAGTTTTACACCTATAAAAGAGA
GAGCCGTTATCGTCTGTTTGTGGATGTACAGAGTGATATTATTGACACGCCCCGGGCGACG
GATGGTGATCCCCCTGGCCAGTGCACGTCTGCTGTGATATAAGTCTCCCGTGAACTTTA
CCCCGTGGTGATATCGGGGATGAAAGCTGGCGCATGATGACCACCGATATGGCCAGTGT
GCCGCTCTCCGTTATCTCGGGGAAGAAGTGGCTGATCTCAGCCACCGCGAAAATGACATCAA
AAAGCCCATTAACCTGATGTTCTGGGGAATATAAATGT CAGGCTCCGTTATACACAGCCA
GTCTGCAGGTGACCATAGTGACTGGATATGTTGTGTTTTACAGTATTATGTAGTCTGTT
TTTTATGCAAAATCTAATTTAATATATTGATATTTATATCATTTTACGTTTCTCGTTCAG
CTTTCTTGTAAGTGGTGATGGGCGGCCGCTCTAGAGGGCCCAAGCTTACGCGTGAT
GCGACGT CATAGCTCTCTCCCTATAGTGAGTCGTATTATAAGCTAGGCACTGGCCGTCGT
TTTACAACGTGCTGACTGGGAAAACCTGCTAGCTTGGGATCTTTGTGAAGGAACCTTACTT
CTGTGGTGATACATAATTGGACAACTACCTACAGAGATTTAAAGCTCTAAGGTAAATAT
AAAATTTTTAAGTGTATAATGTGTTAACTAGCTGCATATGCTTGCTGCTTGAGAGTTTT
GCTTACTGAGTATGATTTATGAAAATATTATACACAGGAGCTAGTGATTCTAATTGTTTG
TGTATTTTAGATTACAGTCCCAAGGCTCATTT CAGGCCCTCAGTCCTCAGAGTCTGTT
CATGATCATAATCAGCCATACCACATTTGTAGAGGTTTTACTTGCTTTAAAAAACCTCCC
ACACCTCCCCCTGAACCTGAAACATAAAATGAATGCAATTGTTGTTGTTAACTTGTTTAT
TGCAGCTTATAATGGTTACAAATAAAGCAATAGCATCACAAATTTACAAATAAAGCATT
TTTTTCACTGCATTCTAGTTGTGGTTTTGTCCAACTCATCAATGTATCTTATCATGTCTG
GATCGATCCTGCATTAATGAATCGGCCAACGCGCGGGGAGAGGCGGTTTGCATATTGGCT
GGCGTAATAGCGAAGAGGCCCCGACCGATCGCCCTTCCCAACAGTTGCGCAGCCTGAATG
GCGAATGGGACGCGCCCTGTAGCGGCGCATTAAAGCGCGGGGTTGTGGTGGTTACGCGCA
GCGTGACCGCTACACTTGCCAGCGCCCTAGCGCCCGCTCCTTTTCGCTTTCTTCCCTTCCT
TTCTCGCCACGTTCCGCGGCTTTCCCGCTCAAGCTCTAAATCGGGGGCTCCCTTTAGGGT-

FIGURE 91B

TCCGATTTAGTGCTTTACGGCACCTCGACCCCAAAAACTTGATTAGGGTGATGGTTTAC
GTAGTGGGCCATCGCCCTGATAGACGGTTTTTCGCCCTTTGACGTTGGAGTCCACGTTCT
TTAATAGTGGACTCTTGTTCAAACTGGAACAACACTCAACCCTATCTCGGTCTATTCTT
TTGATTTTAAAGGGATTTTGCCGATTTCCGGCCTATTGGTTAAAAAATGAGCTGATTTAAC
AAATATTTTAAACGCGAATTTTAAACAAAATATTAACGTTTACAATTTTCGCTGATGCGGTAT
TTTCTCCTTACGCATCTGTGCGGTATTTACACCCGCATACGCGGATCTGCGCAGCACCAT
GGCCTGAAATAACCTCTGAAAGAGGAACTTGGTTAGGTACCTTCTGAGGCGGAAAGAACC
AGCTGTGGAATGTGTGTGAGTTAGGGTGTGGAAAGTCCCCAGGCTCCCCAGCAGGCAGAA
GTATGCAAAGCATGCATCTCAATTAGTCAGCAACCAGGTGTGGAAAGTCCCCAGGCTCCC
CAGCAGGCAGAAGTATGCAAAGCATGCATCTCAATTAGTCAGCAACCATAGTCCCCGCCCC
TAACTCCGCCCCATCCCCGCCCTAACTCCGCCAGTTCCGCCATTCTCCGCCCATGGCT
GACTAATTTTTTTTATTTATGAGAGGCCGAGGCCGCTCGGCCTCTGAGCTATTCCAGA
AGTAGTGAGGAGGCTTTTTTGGAGGCCCTAGGCTTTTGCAAAAAGCTTGATTCTTCTGACA
CAACAGTCTCGAAGCTTAAGACCATGGCCAAAGCCTTTGTCTCAAGAAGAATCCACCTCAT
TGAAAGAGCAACGGCTACAATCAACAGCATCCCCATCTCTGAAGACTACAGCGTCGCCAG
CGCAGCTCTCTAGCGACGGCCGCATCTTCACTGGTGTCAATGTATATCATTTTACTGG
GGGACCTTGTGCAGAACTCGTGGTGCTGGGCACTGCTGCTGCTGCGGCAGCTGGCAACCT
GACTTGTATCGTCGCGATCGGAAATGAGAACAGGGGCATCTTGAGCCCCTGCGGACGGTG
CCGACAGGTGCTTCTCGATCTGCATCCTGGGATCAAAGCCATAGTGAAGGACAGTGATGG
ACAGCCGACGGCAGTTGGGATTCTGTAATTGCTGCCCTCTGGTTATGTGTGGGAGGGCTA
AGCACTTCGTGGCCGAGTTCGAAATGACCGACCAAGCGACGCCCAACCTGCCATCACGAT
GGCCGCAATAAAAATATCTTTATTTTATTACATCTGTGTGTTGGTTTTTTGTGTGAATCG
ATAGCGATAAGGATCCGCGTATGGTGCATCTCAGTACAATCTGCTCTGATGCCGATAG
TTAAGCCAGCCCCGACACCCGCCAACCCCGCTGACGCGCCCTGACGGGCTTGTCTGCTC
CCGGCATCCGCTTACAGACAAGCTGTGACCGTCTCCGGGAGCTGCATGTGTGAGAGGTTT
TCACCGTCATCACGAAACGCGCGAGACGAAAGGGCCTCGTGATACGCCTATTTTATAG
GTTAATGTGATGATAATAATGGTTTTCTTAGACGTCAGGTGGCACTTTTCGGGGAAATGTG
CGCGGAACCCCTATTTGTTTATTTTTCTAAATACATTCAAATATGTATCCGCTCATGAGA
CAATAACCCTGATAAATGCTTCAATAATATTGAAAAAGGAAGAGTATGAGTATTCACAT
TTCCGTGTGCGCCCTTATTCCTTTTTTGCGGCATTTTGCCTTCTGTTTTTGCTCACCCA
GAAACGCTGGTGAAAGTAAAGATGCTGAAGATCAGTTGGGTGCACGAGTGGGTACATC
GAACTGGATCTCAACAGCGGTAAAGATCCTTGAGAGTTTTTCGCCCCGAAGAAGCTTTTCCA
ATGATGAGCACTTTTTAAAGTTCTGCTATGTGGCGCGGTATTATCCCGTATTGACGCCGGG
CAAGAGCAACTCGGTGCGCCGCATACACTATTCTCAGAATGACTTGGTTGAGTACTACCA
GTCACAGAAAAGCATCTTACGGATGGCATGACAGTAAGAGAATTATGCAGTGCTGCCATA
ACCATGAGTGATAACACTGCGGCCAACTTACTTCTGACAACGATCGGAGGACCGAAGGAG
CTAACCGCTTTTTTGCACAACATGGGGGATCATGTAACCTCGCCTTGATCGTTGGGAACCG
GAGCTGAATGAAGCCATACCAAACGACGAGCGTGACACCACGATGCCTGTAGCAATGGCA
ACAACGTTGCGCAAACTATTAACCTGGCGAACTACTTACTCTAGCTTCCCGGCAACAATTA
ATAGACTGGATGGAGGCGGATAAAGTTGCAGGACCACTTCTGCGCTCGGCCCTTCCGGCT
GGCTGGTTTATTGCTGATAAATCTGGAGCCGTTGAGCGTGGGTCTCGCGGTATCATTGCA
GCACTGGGGCCAGATGGTAAGCCCTCCCGTATCGTAGTTATCTACACGACGGGGAGTCAG
GCAACTATGGATGAACGAAATAGACAGATCGCTGAGATAGGTGCCTCACTGATTAAGCAT
TGGTAACTGTGACACCAAGTTTACTCATATATACTTTAGATTGATTTAAAACCTTCATTTT
TAATTTAAAGGATCTAGGTGAAGATCCTTTTTGATAATCTCATGACCAAATCCCTTAA
CGTGAGTTTTTCGTTCCACTGAGCGTCAGACCCCGTAGAAAAGATCAAAGGATCTTCTTGA
GATCCTTTTTTTCTGCGCGTAATCTGCTGCTTGCAACAAAAAACCACCGCTACCAGCG
GTGGTTTGTGTTGCCGGATCAAGAGCTACCAACTCTTTTTCCGAAGGTAACGGCTTCAGC
AGAGCGCAGATACCAATACTGTCTTCTAGTGTAGCCGTAGTTAGGCCACCACTTCAAG
AACTCTGTAGCACCGCTACATACTCGTCTGCTAATCCTGTTACCAAGTGGCTGCTGCC
AGTGGCGATAAGTCTGTCTTACCGGTTGGAGCTCAAGACGATAGTTACCGGATAAGGCG
CAGCGGTCGGGCTGAACGGGGGGTTCTGTGCACACAGCCAGCTTGGAGCGAACGACCTAC
ACCGAACTGAGATACCTACAGCGTGAGCATTGAGAAAGCGCCACGCTTCCCGAAGGGAGA
AAGGCGGACAGGTATCCGGTAAGCGGCAGGGTCGGAACAGGAGAGCGCACGAGGGAGCTT
CCAGGGGGAAACCGCTGGTATCTTTATAGTCTGTGCGGTTTTCGCCACCTCTGACTTGAG
CGTCGATTTTTGTGATGCTCGTCAGGGGGGCGAGCCTATGGAAAAACGCCAGCAACGCG
GCCTTTTTACGGTTCTTGGCCTTTTGTGTCCTTTTGTCTCACATGTTCTTTCTGCGTTA
TCCCCTGATTCTGTGGATAACCGTATTACCGCCTTTGAGTGAGCTGATACCGCTCGCCGC-

FIGURE 91C

AGCCGAACGACCGAGCGCAGCGAGTCAGTGAGCGAGGAAGCGGAAGAGCGCCCAATACGC
AAACCGCCTCTCCCCGCGCGTTGGCCGATTCATTAATGCAGAGCTTGCAATTCGCGCGTT
TTTCAATATTATTGAAGCATTTATCAGGGTTATTGTCTCATGAGCGGATACATATTTGAA
TGTATTTAGAAAAATAAACAAATAGGGGTTCCGCGCACATTTCCCCGAAAAGTGCCACCT
GACGTCTAAGAAACCATTATTATCATGACATTAACCTATAAAAATAGGCGTAGTACGAGG
CCCTTTCACCTCATTAG

FIGURE 91D

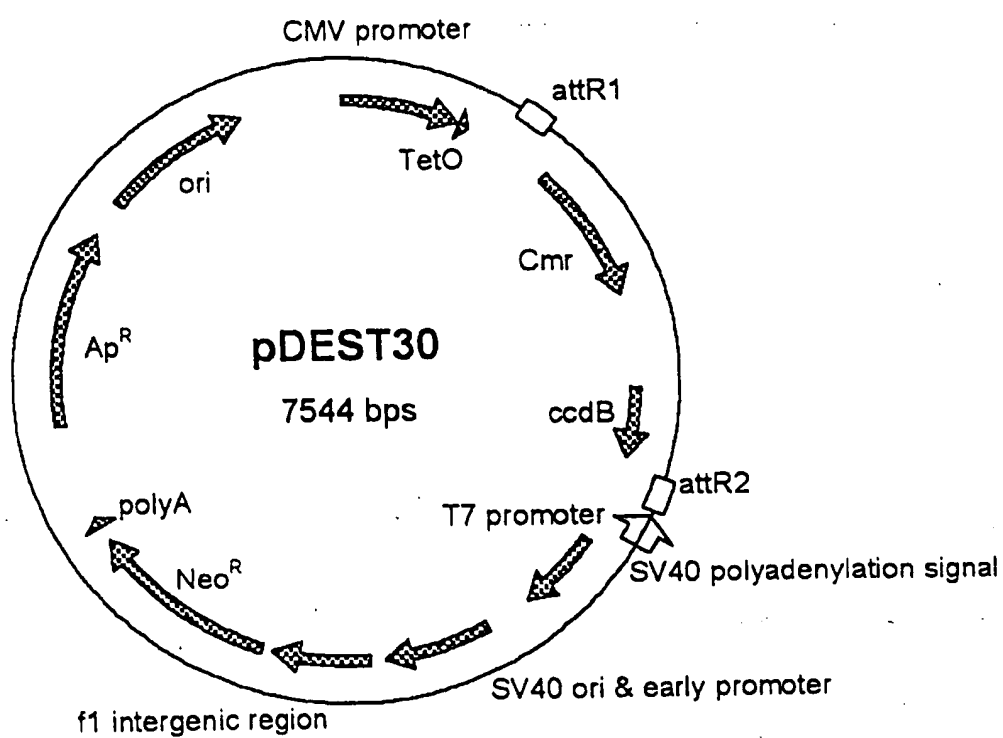


FIGURE 92A

pDEST30 7544 bp

ATGCATGTCGTTACATAACTTACGGTAAATGGCCCCGCTGGCTGACCGCCCAACGACCCC
CGCCCCATTGACGTCAATAATGACGTATGTTCCCATAGTAACGCCAATAGGGACTTTCCAT
TGACGTCAATGGGTGGAGTATTTACGGTAAACTGCCCACTTGGCAGTACATCAAGTGAT
CATATGCCAAGTACGCCCCCTATTGACGTCAATGACGGTAAATGGCCCCGCTGGCATTAT
GCCAGTACATGACCTTATGGGACTTTCCCTACTTGGCAGTACATCTACGTATTAGTCATC
GCTATTACCATGGTGATGCGGTTTGGCAGTACATCAATGGGCGTGGATAGCGGTTTGAC
TCACGGGGATTTCCAAAGTCTCCACCCCATTTGACGTCAATGGGAGTTTGTGTTTGGCACCA
AATCAACGGGACTTTCCAAATGTCGTAACAACTCCGCCCCATTGACGCAATGGGCGGT
AGGCGTGTACGGTGGGAGGTCTATATAAGCAGAGCTCTCCCTATCAGTGATAGAGATCTC
CCTATCAGTGATAGAGATCGTCGACGAGCTCGTTTAGTGAACCGTCAGATCGCCTGGAGA
CGCCATCCACGCTGTTTTGACCTCCATAGAAGACACCGGGACCGATCCAGCCTCCGGACT
CTAGAGGATCCCTACCGGTGATATCCTCGAGCCCATCAACAAGTTTGTACAAAAAAGCTG
AACGAGAAACGTAAAATGATATAAATATCAATATATTAAATTAGATTTTGCATAAAAAAC
AGACTACATAATACTGTAAAAACACAACATATCCAGTCACTATGGCGGCCGATTAGGCAC
CCCAGGCTTTACACTTTATGCTTCCGGCTCGTATAATGTGTGGATTTTGAAGTTAGGATCC
GGCGAGATTTTCAGGAGCTAAGGAAGCTAAAATGGAGAAAAAATCACTGGATATACCAC
CGTTGATATATCCCAATGGCATCGTAAAGAACATTTTGAAGCATTTTCAGTCAGTTGCTCA
ATGTACCTATAACCAGACCGTTAGCTGGATATTACGGCCTTTTTAAAGACCGTAAAGAA
AAATAAGCACAGTTTTATCCGGCCTTTATTCACATTCTTGCCCCGCTGATGAATGCTCA
TCCGGAATTCGCTATGGCAATGAAAGACGGTGAGCTGGTGATATGGGATAGTGTTCACCC
TTGTTACACCGTTTTCCATGAGCAAACTGAAACGTTTTTCATCGCTCTGGAGTGAATACCA
CGACGATTTCCGGCAGTTTCTACACATATATTGCAAGATGTGGCGTGTACGGTGAAAA
CCTGGCCTATTTCCCTAAAGGTTTATTGAGAAATATGTTTTTCTGCTCAGCCAATCCCTG
GGTGAGTTTACCAGTTTGTATTAAACGTGGCCAATATGGACAACTTCTTCCCCCGCT
TTTACCATGGGCAAAATATTATACGCAAGGCGACAAGGTGCTGATGCCGCTGGCGATTCA
GGTTTCATCATGCGCTCTGTGATGGCTTCCATGTGCGCAGAATGCTTAATGAATTACAACA
GTACTGCGATGAGTGGCAGGGCGGGCGTAAAGATCTGGATCCGGCTTACTAAAAGCCAG
ATAACAGTATGCGTATTTGCGCGCTGATTTTTGCGGTATAAGAATATATACTGATATGTA
TACCCGAAGTATGTCAAAAAGAGGTGTGCTATGAAGCAGCGTATTACAGTGACAGTTGAC
AGCGACAGCTATCAGTTGCTCAAGGCATATATGATGTCAATATCTCCGGTCTGGTAAGCA
CAACCATGCAGAATGAAGCCCCGTCGTCTGCGTGCCGAACGCTGGAAAGCGGAAATCAGG
AAGGGATGGCTGAGGTGCGCCCGTTTATTGAAATGAACGGCTCTTTTGCTGACGAGAACA
GGGACTGGTGAAATGCAGTTTAAGGTTTACACCTATAAAAAGAGAGAGCCGTTATCGTCTG
TTTGTGGATGTACAGAGTGATATTATTGACACGCCCCGGGCGACGGATGGTGATCCCCCTG
GCCAGTGCACGTCTGCTGTGATGATAAGTCTCCCGTGAACTTTACCCGGTGGTGATATC
GGGGATGAAAAGCTGGCGCATGATGACCACCGATATGGCCAGTGTGCCGGTCTCCGTTATC
GGGGAAGAAGTGGCTGATCTCAGCCACCGGAAATGACATCAAAAACGCCATTAACTG
ATGTTCTGGGAATATAAATGTGAGGCTCCCTTATACACAGCCAGTCTGCAGGTGACCA
TAGTGACTGGATATGTTGTGTTTTACAGTATTATGTAGTCTGTTTTTTATGCAAAATCTA
ATTTAATATATTGATATTTATATCATTTTACGTTTCTCGTTTCTGTTTCTGTACAAAGT
GGTTGATGGGCGGCCGCTCTAGAGGGCCCCAAGCTTACGCGTGCATGCGACGTATAGCTC
TCTCCCTATAGTGAGTCGTATTATAAGCTAGGCACTGGCCGTGTTTTTACAACGTCGTGA
CTGGGAAAACCTGCTAGCTTGGGATCTTTGTGAAGGAACCTTACTTCTGTGGTGTGACATA
ATTGGACAAACTACCTACAGAGATTTAAAGCTCTAAGGTAAATATAAAATTTTTAAGTGT
ATAATGTGTTAAACTAGCTGCATATGCTTGCTGCTTGAGAGTTTTGCTTACTGAGTATGA
TTTATGAAAATATTATACACAGGAGCTAGTGATTCTAATTGTTTGTGATTTTATGATTCA
CAGTCCCAAGGCTCATTTACAGCCCCCTCAGTCTCACAGTCTGTTTATGATCATAATCAG
CCATACCACATTTGTAGAGGTTTTACTTGCTTTAAAAAACCTCCACACCTCCCCCTGAA
CCTGAAACATAAAATGAATGCAATTGTTGTTGTTAACTTGTTTATTGACAGCTTATAATGG
TTACAAAATAAAGCAATAGCATCACAAATTTACAAATAAAGCATTTTTTCACTGCATT
TAGTTGTGGTTTTGTCCAAACTCATCAATGTATCTTATCATGTCTGGATCGATCCTGCATT
AATGAATCGGCCAACGCGCGGGGAGAGGCGGTTTGGCGTATTGGCTGGCGTAATAGCGAAG
AGGCCCGCACCGATCGCCCTTCCCAACAGTTGCGCAGCCTGAATGGCGAATGGGACGCGC
CCTGTAGCGGCGCATTAAGCGCGGGGTGTGGTGGTTACGCGCAGCGTGACCGCTACAC
TTGCCAGCGCCCTAGCGCCCGCTCCTTTGCTTTCTTCCCTTCTTCTCGCCACGTTTCG
CCGGCTTTCCCGCTCAAGCTCTAAATCGGGGGCTCCCTTTAGGGTTCCGATTTAGTGCTT-

TACGGCACCTCGACCCCAAAAACTTGATTAGGGTGATGGTTCACGTAGTGGGCCATCGC
CCTGATAGACGGTTTTTTCGCCCTTTGACGTTGGAGTCCACGTTCTTTAATAGTGGACTCT
TGTTCCAAACTGGAACAACACTCAACCCTATCTCGGTCTATTCTTTTGATTTATAAGGGA
TTTTGCCGATTTCGGCCTATTGGTTAAAAAATGAGCTGATTTAACAAATATTTAACGCGA
ATTTTAACAAAATATTAACGTTTACAATTTTCGCCCTGATGCGGTATTTTCTCCTTACGCAT
CTGTGCGGTATTTTACACCCGCATACGCGGATCTGCGCAGCACCATGGCCTGAAATAACCT
CTGAAAGAGGAACTTGGTTAGGTACCTTCTGAGGCGGAAAGAACCAGCTGTGGAATGTGT
GTCAGTTAGGGTGTGGAAAGTCCCCAGGCTCCCCAGCAGGCAGAAGTATGCAAAGCATGC
ATCTCAATTAGTCAGCAACCAGGTGTGGAAAGTCCCCAGGCTCCCCAGCAGGCAGAAGTA
TGCAAAGCATGCATCTCAATTAGTCAGCAACCATAGTCCCGCCCCCTAACTCCGCCCCATCC
CGCCCCCTAACTCCGCCCCAGTTCCGCCCCATTCTCCGCCCCATGGCTGACTAATTTTTTTTA
TTTATGCAGAGGCCGAGGCCGCTCGGCCTCTGAGCTATTCCAGAAGTAGTGAGGAGGCT
TTTTTGAGGCTTAGGCTTTTGCAAAAAGCTTGATTCTTCTGACACAACAGTCTCGAAGT
TAAGGCTAGAGCCACCATTGATTGAACAAGATGGATTGCACGCAGGTTCTCCGGCCGCTTG
GGTGGAGAGGCTATTTCGGCTATGACTGGGCACAACAGACAATCGGCTGCTCTGATGCCGC
CGTGTTCGGCTGTGACGCGAGGGGCGCCCGGTTCTTTTTGTCAAGACCGACCTGTCCGG
TGCCCTGAATGAACTGCAGGACGAGGCGAGGCTATCGTGGCTGGCCACGACGGGCGT
TCCTTGCGCAGCTGTGCTCGACGTTGTCACTGAAGCGGGAAGGGACTGGCTGCTATTGGG
CGAAGTGCCGGGGCAGGATCTCCTGTCATCTCACCTTGCTCCTGCCGAGAAAGTATCCAT
CATGGCTGATGCAATGCGGCGGCTGCATACGCTTGATCCGGCTACCTGCCCCATTCGACCA
CCAAGCGAAACATCGCATCGAGCGAGCACGTAAGCGGATGGAAGCCGGTCTTGTTCGATCA
GGATGATCTGGACGAAGAGCATCAGGGGCTCGCGCCAGCCGAAGTTCGCCAGGCTCAA
GGCGCGCATGCCCGACGGCGAGGATCTCGTCTGACCCATGGCGATGCCTGCTTGCCGAA
TATCATGGTGGAAAATGGCCGCTTTTTCTGGATTTCATCGACTGTGGCCGGCTGGGTGTGGC
GGACCGCTATCAGGACATAGCCTTGGCTACCCGTGATATTGCTGAAGAGCTTGGCGGCGA
ATGGGCTGACCGCTTCTCGTGCTTTACGGTATCGCCGCTCCCGATTTCGACGCGCATCGC
CTTCTATCGCCTTCTTGACGAGTTCTTCTGAGCGGGACTCTGGGGTTTCAAAATGACCGAC
CAAGCGACGCCCCAACCTGCCATCACGATGGCCGCAATAAAATATCTTTATTTTCATTACA
TCTGTGTGTTGGTTTTTTTGTGTGAATCGATAGCGATAAGGATCCGCGTATGGTGCATCT
CAGTACAATCTGCTCTGATGCCGCATAGTTAAGCCAGCCCCGACACCCGCCAACACCCGC
TGACGCGCCCTGACGGGCTTGTCTGCTCCCGGCATCCGCTTACAGACAAGCTGTGACCGT
CTCCGGGAGCTGCATGTGTGAGAGTTTTTACCCTCATCACCAGAAACGCGGAGACGAAA
GGCCCTCGTGATACGCCATTTTTATAGTTAATGTGATGATAAATAATGGTTTCTTAGAC
GTCAGGTGGCACTTTTCGGGAAATGTGCGCGGAACCCCTATTTGTTTTATTTTTCTAAAT
ACATTCAAATATGTATCCGCTCATGAGACAATAACCCTGATAAATGCTTCAATAATATTG
AAAAAGGAAGAGTATGAGTATTCAACATTTCCGTGTGCGCCTTATTCCCTTTTTTTCGCGC
ATTTTGCCCTTCTGTTTTTGTCTACCCAGAAACGCTGGTGAAAGTAAAAGATGCTGAAGA
TCAGTTGGGTGCACGAGTGGGTTACATCGAAGTGGATCTCAACAGCGGTAAGATCCTTGA
GAGTTTTTCGCCCCGAAGAAGCTTTTCCAATGATGAGCACTTTTAAAGTTCTGCTATGTGG
CGCGGTATTATCCCGTATTGACGCGGGGCAAGAGCAACTCGGTGCGCCGCATACACTATTC
TCAGAATGACTTGGTTGAGTACTACCAAGTCACAGAAAAGCATCTTACGGATGGCATGAC
AGTAAGAGAATTATGCAGTGTCTGCCATAACCATGAGTGATAAACTGCGGCCAAGCTTACT
TCTGACAACGATCGGAGGACCGAAGGAGCTAACCGCTTTTTTGCACAACATGGGGGATCA
TGTAACCTGCGCTTGATCGTTGGGAACCGGAGCTGAATGAAGCCATACCAAACGACGAGCG
TGACACCACGATGCCTGTAGCAATGGCAACAACGTTGCGCAAACTATTAAGTGGCGAACT
ACTTACTCTAGCTTCCCGGCAACAATTAATAGACTGGATGGAGGCGGATAAAGTTGCAGG
ACCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTATTGCTGATAAATCTGGAGCCGG
TGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCAGATGGTAAGCCCTCCCGTAT
CGTAGTTATCTACACGACGGGGAGTCAGGCAACTATGGATGAACGAAATAGACAGATCGC
TGAGATAGGTGCCTCACTGATTAAGCATTTGGTAACTGTCAGACCAAGTTTACTCATATAT
ACTTTAGATTGATTTAAACTTTCATTTTTAATTTAAAAGGATCTAGGTGAAGATCCTTTT
TGATAATCTCATGACCAAAATCCCTTAACGTGAGTTTTCGTTCCACTGAGCGTCAGACCC
CGTAGAAAAGATCAAGGATCTTCTTGAGATCCTTTTTTTCTGCGCGTAATCTGCTGCTT
GCAAAACAAAAAACCCCGCTACCAGCGGTGGTTTGTGTTGCCGGATCAAGAGCTACCAAC
TCTTTTTCCGAAGGTAAGTGGCTTCAGCAGAGCGCAGATACCAATACTGTCCTTCTAGT
GTAGCCGTAGTTAGGCCACCACTTCAAGAACTCTGTAGCACCGCCTACATACCTCGCTCT
GCTAATCCTGTTACCAAGTGGCTGCTGCCAGTGGCGATAAGTCGTGTCTTACCGGGTTGGA
CTCAAGACGATAGTTACCGGATAAGGCGCAGCGGTGCGGCTGAACGGGGGTTCGTGCAC-

ACAGCCCAGCTTGGAGCGAACGACCTACACCGAACTGAGATACCTACAGCGTGAGCATTG
AGAAAGCGCCACGCTTCCCGAAGGGAGAAAGGCGGACAGGTATCCGGTAAGCGGCAGGGT
CGGAACAGGAGAGCGCACGAGGGAGCTTCCAGGGGGAAACGCCTGGTATCTTTATAGTCC
TGTCGGGTTTCGCCACCTCTGACTTGAGCGTCGATTTTTGTGATGCTCGTCAGGGGGGCG
GAGCCTATGGAAAAACGCCAGCAACGCGGCCTTTTTACGGTTCCTGGCCTTTTGCTGGCC
TTTTGCTCACATGTTCTTTCCTGCGTTATCCCCTGATTCTGTGGATAACCGTATTACCGC
CTTTGAGTGAGCTGATACCGCTCGCCGAGCCGAACGACCGAGCGCAGCGAGTCAGTGAG
CGAGGAAGCGGAAGAGCGCCCAATACGCAAACCGCCTCTCCCGCGCGTTGGCCGATTCA
TTAATGCAGAGCTTGCAATTCGCGCGTTTTTCAATATTATTGAAGCATTATCAGGGTTA
TTGTCTCATGAGCGGATACATATTTGAATGTATTTAGAAAAATAAACAAATAGGGGTTCC
GCGCACATTTCCCGAAAAGTGCCACCTGACGTCTAAGAAACCATTATTATCATGACATT
AACCTATAAAAATAGGCGTAGTACGAGGCCCTTTCATCATTAG

FIGURE 92D

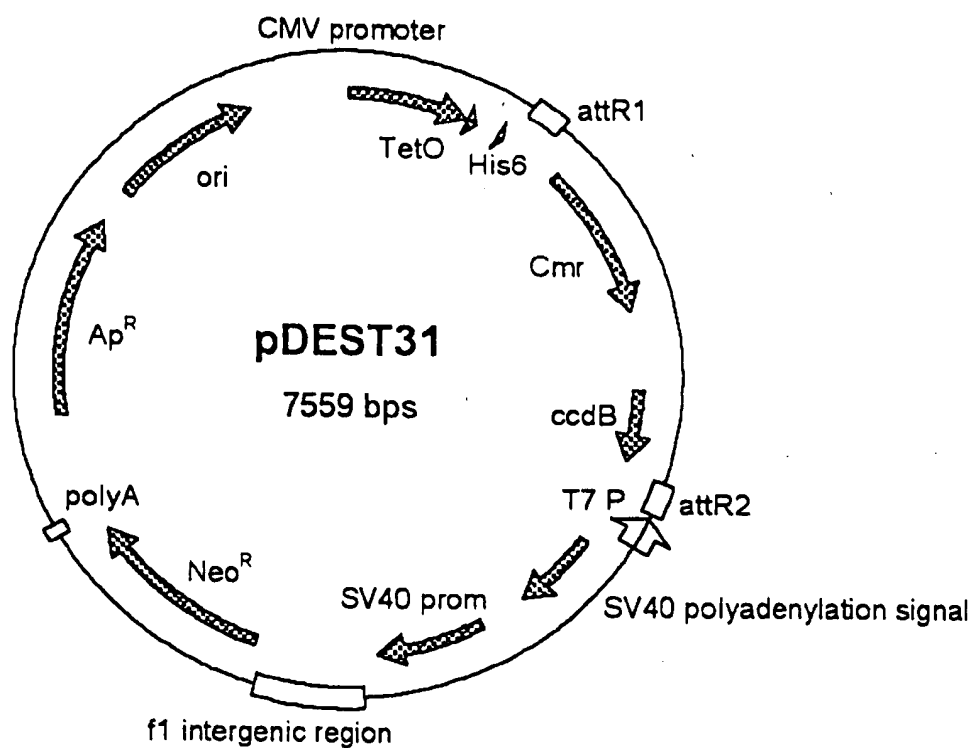


FIGURE 93A

214/240
pDEST31 7559 bp

ATGCATGTCGTTACATAACTTACGGTAAATGGCCCGCCTGGCTGACCGCCCAACGACCCC
CGCCCATTTGACGTCAATAATGACGTATGTTCCCATAGTAACGCCAATAGGGACTTTCCAT
TGACGTCAATGGGTGGAGTATTTACGGTAAACTGCCCACTTGGCAGTACATCAAGTGTAT
CATATGCCAAGTACGCCCCCTATTGACGTCAATGACGGTAAATGGCCCGCCTGGCATTAT
GCCCAGTACATGACCTTATGGGACTTTCTACTTTGGCAGTACATCTACGTATTAGTCATC
GCTATTACCATGGTGATGCGGTTTTTGGCAGTACATCAATGGGCGTGGATAGCGGTTTTGAC
TCACGGGGATTTCCTAAGTCTCCACCCATTGACGTCAATGGGAGTTTGTGTTTGGCACCAA
AATCAACGGGACTTTTCCAAAATGTCTGTAACAACCTCCGCCCCATTGACGCAATGGGCGGT
AGGCGTGTACGGTGGGAGGTCTATATAAGCAGAGCTCTCCCTATCAGTGATAGAGATCTC
CCTATCAGTGATAGAGATCGTCGACGAGCTCGTTTTAGTGAACCGTCAGATCGCCTGGAGA
CGCCATCCACGCTGTTTTGACCTCCATAGAAGACACCGGGACCGATCCAGCCTCCGGACC
ATGGCGTACTACCATCACCATCACCATCACACCGGTGATATCCTCGAGCCCATCACAAAT
TTGTACAAAAAAGCTGAACGAGAAACGTAAAAATGATATAAAATATCAATATATTAAATTAG
ATTTTGCATAAAAAACAGACTACATAACTGTAAACACAACATATCCAGTCACTATGG
CGGCCGCATTAGGCACCCAGGCTTTACACTTTTATGCTTCCGGCTCGTATAATGTGTGGA
TTTTGAGTTAGGATCCGGCGAGATTTTCAGGAGCTAAGGAAGCTAAAATGGAGAAAAAAA
TCACTGGATATACACCGTTGATATATCCCAATGGCATCGTAAAGAACATTTTGGAGGCAT
TTCAGTCAGTTGCTCAATGTACCTATAACCAGACCGTTGAGCTGGATATTACGGCCTTTT
TAAAGACCGTAAAGAAAAATAAGCACAAGTTTTATCCGGCCTTTATTACATTCTTGCCC
GCCTGATGAATGCTCATCCGGAATTCGGTATGGCAATGAAAGACGGTGAGCTGGTGATAT
GGGATAGTGTTCACCTTGTACACCGTTTTCCATGAGCAAACCTGAAACGTTTTTCATCGC
TCTGGAGTGAATACACGACGATTTCCGGCAGTTTCTACACATATATTGCAAGATGTGG
CGTGTTACGGTGAAAACCTGGCCTATTTCCCTAAAGGGTTTATTGAGAATATGTTTTTCG
TCTCAGCCAATCCCTGGGTGAGTTTTACCAGTTTTGATTTTAAACGTGGCCAATATGGACA
ACTTCTTCGCCCCCGTTTTCCATGGGCAAATATTATACGCAAGGCGACAAGGTGCTGA
TGCCGCTGGCGATTTCAGGTTTCATCATGCCGTCTGTGATGGCTTCCATGTCCGCAGAATGC
TTAATGAATTACAACAGTACTGCGATGAGTGGCAGGGCGGGGCGTAAACCGGTGGATCCG
GCTTACTAAAAGCCAGATAACAGTATGCGTATTTGCGCGCTGATTTTTGCGGTATAAGAA
TATATACTGATATGTATACCCGAAGTATGTCAAAAAGAGGTGTGCTATGAAGCAGCGTAT
TACAGTGACAGTTGACAGCGACAGCTATCAGTTGCTCAAGGCATATATGATGTCAATATC
TCCGGTCTGGTAAGCACAACCATGCAGAATGAAGCCCGTCGTCTGCGTGCCGAACGCTGG
AAAGCGGAAAATCAGGAAGGGATGGCTGAGGTGCGCCCGTTTTATTGAAATGAACGGCTCT
TTTGCTGACGAGAACAGGGACTGGTGAAATGCAGTTTAAAGGTTTACACCTATAAAAGAGA
GAGCCGTTATCGTCTGTTTTGTGGATGTACAGAGTGATATTATTGACAGCCCCGGGCGACG
GATGGTGATCCCCCTGGCCAGTGCACGTCTGCTGTGATGATAAAGTCTCCCGTGAACTTTA
CCCCGTTGGTGATATCGGGGATGAAAGCTGGCGCATGATGACCACCGATATGGCCAGTGT
GCCGCTCTCCGTTATCGGGGAAGAAGTGGCTGATCTCAGCCACCGCGAAAATGACATCAA
AAACGCCATTAACTGATGTTCTGGGGAATATAAATGTGAGGCTCCGTTATACACAGCCA
GTCTGCAGGTGACCATAGTGACTGGATATGTTGTGTTTTACAGTATTATGTAGTCTGTT
TTTTATGCAAAATCTAATTTAATATATTGATATTTATATCATTTTACGTTTTCTCGTTT
CTTTCTTGTACAAAGTGGTGATGGGCGGCCGCTCTAGAGGGCCCAAGCTTACGCGTGCAT
GCGACGTATAGCTCTCTCCCTATAGTGAGTCTGATTTATAAGCTAGGCACTGGCCGTGCT
TTTACAACGTCGTGACTGGGAAAACCTGACTGCTTGGGATCTTTGTGAAGGAACCTTACTT
CTGTGGTGTGACATAATTGGACAACTACCTACAGAGATTTAAAGCTCTAAGGTAAATAT
AAAATTTTTTAAGTGTATAATGTGTTAACTAGCTGCATATGCTTGCTGCTTGAGAGTTTT
GCTTACTGAGTATGATTTATGAAAATATTATACACAGGAGCTAGTGATTCTAATTGTTTTG
TGATTTTTAGATTACAGTCCCAAGGCTCATTTTCAGGCCCTCAGTCTCACAGTCTGTT
CATGATCATAATCAGCCATACCACATTTGTAGAGGTTTTACTTGCTTTAAAAAACCTCCC
ACACCTCCCCCTGAACCTGAAACATAAAATGAATGCAATTGTTGTTGTTAACTTGTATTAT
TGCAGCTTATAATGGTTACAAATAAAGCAATAGCATCACAAATTTACAAATAAAGCATT
TTTTTCACTGCATTCTAGTTGTGGTTTGTCCAAACTCATCAATGTATCTTATCATGTCTG
GATCGATCCTGCATTAATGAATCGGCCAACGCGGGGAGAGGCGGTTTGGCGTATTGGCT
GGCGTAATAGCGAAGAGGCCCGCACCGATCGCCCTTCCCAACAGTTGCGCAGCCTGAATG
GCCAATGGGACGCGCCCTGTAGCGGCGCATTAAGCGCGGCGGGTGTGGTGGTTACGCGCA
GCGTGACCGCTACACTTGCCAGCGCCCTAGCGCCCGCTCCTTTTCGTTTTCTTCCCTTCCCT
TTCTCGCCACGTTCCGCGGCTTTCCCGCTCAAGCTCTAAATCGGGGGCTCCCTTTAGGGT-

FIGURE 93B

TCCGATTTAGTGCTTTACGGCACCTCGACCCCCAAAAAATTGATTAGGGTGATGGTTTCAC
GTAGTGGGCCCATCGCCCTGATAGACGGTTTTTCGCCCTTTGACGTTGGAGTCCACGTTCT
TTAATAGTGGACTCTTGTTCCAAACTGGAACAACACTCAACCCTATCTCGGTCTATTCTT
TTGATTTATAAGGGATTTTGCCGATTTCCGGCCTATTGGTTAAAAAATGAGCTGATTTAAC
AAATATTTAAACGCGAATTTTAACAAAATATTAACGTTTACAATTTTCGCTGATGCGGTAT
TTTCTCCTTACGCATCTGTGCGGTATTTACACCCGCATACGCGGATCTGCGCAGCACCAT
GGCCTGAAATAACCTCTGAAAGAGGAACCTTGGTTAGGTACCTTCTGAGGCGGAAAGAACC
AGCTGTGGAATGTGTGTGTCAGTTAGGGTGTGGAAGTCCCCAGGCTCCCCAGCAGGCAGAA
GTATGCAAAGCATGCATCTCAATTAGTCAGCAACCAGGTGTGGAAGTCCCCAGGCTCCC
CAGCAGGCAGAAGTATGCAAAGCATGCATCTCAATTAGTCAGCAACCATAGTCCCCGCCCC
TAACTCCGCCCCATCCCGCCCCCTAACTCCGCCCCAGTTCCGCCCCATTCTCCGCCCCATGGCT
GACTAATTTTTTTTTATTTATGTCAGAGGCCGAGGCCGCTCGGCCTCTGAGCTATTCCAGA
AGTAGTGAGGAGGCTTTTTTGGAGGCCTAGGCTTTTGCAAAAAGCTTGATTCTTCTGACA
CAACAGTCTCGAACTTAAGGCTAGAGCCACCATGATTGAACAAGATGGATTGCACGCAGG
TTCTCCGGCCGCTTGGGTGGAGAGGCTATTCGGCTATGACTGGGCACAACAGACAACTCGG
CTGTCTGATGCCCCGTGTTCCGGCTGTACGCGCAGGGCGCCCGGTTCTTTTTGTCAA
GACCGACCTGTCCGGTGCCCTGAATGAACTGCAGGACGAGGCAGCGCGGCTATCGTGGCT
GGCCACGACGGGCGTTCTTGCAGCTGTGCTCGACGTTGTCACTGAAGCGGGAAGGGA
CTGGCTGCTATTGGGCGAAGTGCCGGGGCAGGATCTCCTGTCATCTCACCTTGCTCCTGC
CGAGAAAGTATCCATCATGGCTGATGCAATGCGGCGGCTGCATACGCTTGATCCGGCTAC
CTGCCCATTCGACCACCAAGCGAAACATCGCATCGAGCGAGCACGTACTCGGATGGAAGC
CGGTCTTGTGATCAGGATGATCTGGACGAAGAGCATCAGGGGCTCGCGCCAGCCGAACCT
GTTCCGCCAGGCTCAAGGCGCGCATGCCCGACGGCGAGGATCTCGTCGTGACCCATGGCGA
TGCCTGCTTGCCGAATATCATGGTGGAAAATGGCCGCTTTTCTGGATTCTCGACTGTGG
CCGGCTGGGTGTGGCGGACCGCTATCAGGACATAGCGTTGGCTACCCGTGATATTGCTGA
AGAGCTTGGCGCGAATGGGCTGACCGCTTCCCTCGTGCTTTACGGTATCGCCGCTCCCGA
TTCGACGCGCATCGCCTTCTATCGCCTTCTTGACGAGTTCTTCTGAGCGGGACTCTGGGG
TTCGAAATGACCGACCAAGCGACGCCCAACCTGCCATCACGATGGCCGCAATAAATATC
TTTATTTTTCATTACATCTGTGTGTGGTTTTTTGTGTGAATCGATAGCGATAAGGATCCG
CGTATGGTGCATCTCAGTACAATCTGCTCTGATGCCGCATAGTTAAGCCAGCCCCGACA
CCCGCCAACACCCGCTGACGCGCCCTGACGGGCTTGTCTGCTCCCGGCATCCGCTTACAG
ACAAGCTGTGACCGTCTCCGGGAGCTGCATGTGTGTCAGAGGTTTTACCCGTCTACCCGAA
ACGCGCGAGACGAAAGGGCCTCGTGATACGCCATTTTTATAGGTTAATGTCTGATAAT
AATGGTTTTCTTAGACGTCAGGTGGCACTTTTCGGGAAATGTGCGCGGAACCCCTATTG
TTTTATTTTCTAAATACATTCAAATATGTATCCGCTCATGAGACAATAACCCTGATAAAT
GCTTCAATAATATTGAAAAGGAAGAGTATGAGTATTCAACATTTCCGTGTGCGCCCTTAT
TCCCTTTTTTGCGGCATTTTGCCTTCTGTTTTTGTCTACCCAGAAACGCTGGTGAAAGT
AAAAGATGCTGAAGATCAGTTGGGTGCACGAGTGGGTACATCGAACTGGATCTCAACAG
CGGTAAGATCCTTGAGAGTTTTCGCCCCGAAGAACGTTTTTCCAATGATGAGCACTTTTAA
AGTTCTGCTATGTGGCGCGGTATTATCCCGTATTGACGCGGGGCAAGAGCAACTCGGTG
CCGCATACACTATTCTCAGAATGACTTGGTTGAGTACTCACCACTCACAGAAAAGCATCT
TACGGATGGCATGACAGTAAGAGAATTATGCAGTGCTGCCATAACCATGAGTGATAACAC
TGCGGCCAACTTACTTCTGACAACGATCGGAGGACCGAAGGAGCTAACCGCTTTTTTGCA
CAACATGGGGGATCATGTAACCTCGCCTTGATCGTTGGGAACCGGAGCTGAATGAAGCCAT
ACCAAACGACGAGCGTGACACCAGATGCCTGTAGCAATGGCAACAACGTTGCGCAAACT
ATTAACCTGGCGAACTACTTACTCTAGCTTCCCGGCAACAATTAATAGACTGGATGGAGGC
GGATAAAGTTGCAGGACCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTATTGCTGA
TAAATCTGGAGCCGGTGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCAGATGG
TAAGCCCTCCCGTATCGTAGTTATCTACACGACGGGGAGTCAGGCAACTATGGATGAACG
AAATAGACAGATCGCTGAGATAGGTGCCTCACTGATTAAGCATTGGTAACCTGTGACACCA
AGTTTACTCATATATACTTTAGATTGATTTAAAACCTTCATTTTTAATTTAAAAGGATCTA
GGTGAAGATCCTTTTTTGATAATCTCATGACCAAAATCCCTTAACGTGAGTTTTCTGTTCCA
CTGAGCGTCAGACCCCGTAGAAAAGATCAAAGGATCTTCTTGAGATCCTTTTTTCTGCG
CGTAATCTGCTGTGTCGAAACAAAAAACCCGCTACCAGCGGTGGTTTGTGTTGCCGGA
TCAAGAGCTACCAACTCTTTTTCCGAAGGTAACCTGGCTTCAGCAGAGCGCAGATACCAAA
TACTGTCCTTCTAGTGTAGCCGTAGTTAGGCCACCACTTCAAGAACTCTGTAGCACCGCC
TACATACCTCGCTCTGCTAATCCTGTTACCAGTGGCTGCTGCCAGTGGCGATAAGTCGTG
TCTTACCGGTTGGACTCAAGACGATAGTTACCGGATAAGGCGCAGCGTCCGGCTGAAC-

FIGURE 93C

GGGGGGTTCTGTGCACACAGCCCAGCTTGGAGCGAACGACCTACACCGAACTGAGATACCT
ACAGCGTGAGCATTGAGAAAGCGCCACGCTTCCCGAAGGGAGAAAGGCGGACAGGTATCC
GGTAAGCGGCAGGGTCGGAACAGGAGAGCGCACGAGGGAGCTTCCAGGGGGAAACGCCTG
GTATCTTTATAGTCCTGTCTGGGTTTTCGCCACCTCTGACTTGAGCGTCGATTTTGTGATG
CTCGTCAGGGGGGCGGAGCCTATGGAAAAACGCCAGCAACGCGGCCTTTTACGGTTCTCT
GGCCTTTTGCTGGCCTTTTGCTCACATGTTCTTCTGCGTTATCCCCTGATTCTGTGGA
TAACCGTATTACCGCCTTTGAGTGAGCTGATACCGCTCGCCGCAGCCGAACGACCGAGCG
CAGCGAGTCAGTGAGCGAGGAAGCGGAAGAGCGCCCAATACGCAAACCGCCTCTCCCCGC
GCGTTGGCCGATTCATTAATGCAGAGCTTGCAATTTCGCGCGTTTTTCAATATTATTGAAG
CATTTATCAGGGTTATTGTCTCATGAGCGGATACATATTTGAATGTATTTAGAAAAATAA
ACAAATAGGGGTTCCGCGCACATTTCCCCGAAAAGTGCCACCTGACGTCTAAGAAACCAT
TATTATCATGACATTAACCTATAAAAAATAGGCGTAGTACGAGGCCCTTCACTCATTAG

FIGURE 93D

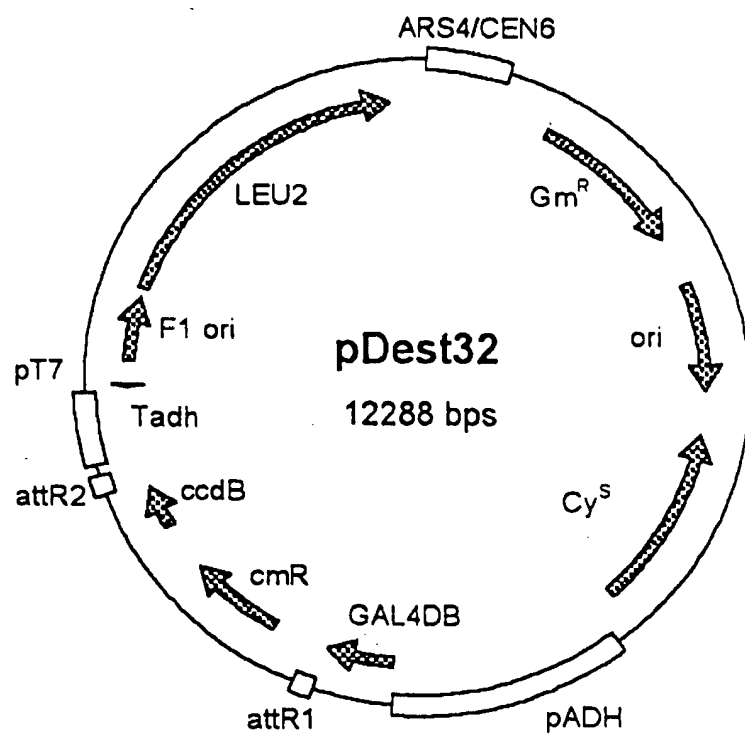


FIGURE 94A

pDEST32 12288 bp

GACGAAAGGGCCTCGTGATACGCCTATTTTTATAGGTTAATGTCATGATAATAATGGTTT
CTTAGGACGGATCGCTTGCCCTGTAACCTTACACGCGCTCGTATCTTTAATGATGGAATA
ATTTGGGAATTTACTCTGTGTTTATTTATTTTATGTTTTGTATTTGGATTTTAGAAAGT
AAATAAAGAAGGTAGAAGAGTTACGGAATGAAGAAAAAAATAAACAAAGGTTTAAAAA
ATTTCAACAAAAAGCGTACTTTACATATATATTTATTAGACAAGAAAAGCAGATTAAATA
GATATACATTTCGATTAACGATAAGTAAAATGTAAAATCACAGGATTTTCGTGTGTGGTCT
TCTACACAGACAAGATGAAACAATTCCGCATTAATACCTGAGAGCAGGAAGAGCAAGATA
AAAGGTAGTATTTGTTGGCGATCCCCCTAGAGTCTTTTACATCTTCGGAAAACAAAACT
ATTTTTTCTTTAATTTCTTTTTTTTACTTTCTATTTTAAATTTATATATTTATTTAAAAA
ATTTAAATTATAATTATTTTATAGCACGTGATGAAAAGGACCCAGGTGGCACTTTTCGG
GGAAATGTGCGCGGAACCCCTATTTGTTTATTTTCTAAATACATTCAAATATGTATCCG
CTCATGAGACAATAACCCCTGATAAATGCTTCAATAATCTGCAGTGCAGGCGCGTGTCT
TCAAAATCTCTGATGTTACATTGCACAAGATAAAAAATATATCATCATGAACAATAAACT
GTCTGCTTACATAAAGAGTAATACAAGGGTGTATGAGCCATATTCAACGGGAAACGTC
TTGCTGGAGGCGCGGATTAAATTCCAACATGGATGCTGATTTATATGGGTATAAATGGGC
TCGGTAGCCAACCACTAGAACTATAGCTAGAGTCTGGGCGAACAACGATGCTCGCCTT
CCAGAAAACCGAGGATGCGAACCCTTCATCCGGGGTCAGCACCACCGGCAAGCGCCGCG
ACGGCCGAGGTCTTCCGATCTCCTGAAGCCAGGGCAGATCCGTGCACAGCACCTTGCCGT
AGAAGAACAGCAAGGCCGCAATGCCTGACGATGCGTGGAGACCGAAACCTTGCGCTCGT
TCGCCAGCCAGGACAGAAATGCCTCGACTTCGCTGCTGCCCCAAGGTTGCCGGTGACGCA
CACCGTGGAACGGATGAAGGCACGAACCCAGTTGACATAAGCCTGTTTCGGTTTCGTAAAC
TGTAATGCAAGTAGCGTATGCGCTCAGCAACTGGTCCAGAACCTTGACCGAACGCAGCG
GTGGTAACGGCGCAGTGGCGGTTTTCATGGCTTGTTATGACTGTTTTTTGTACAGTCTA
TGCCCTCGGGCATCCAAGCAGCAAGCGCGTTACGCCGTGGGTGATGTTTGATGTTATGGA
GCAGCAACGATGTTACGCAGCAGCAACGATGTTACGCAGCAGGGCAGTCGCCCTAAAACA
AAGTTAGGTGGCTCAAGTATGGGCATCATTGCGCATGTAGGCTCGGCCCTGACCAAGTC
AAATCCATGCGGGCTGCTCTTGATCTTTTCGGTCTGAGTTTCGGAGACGTAGCCACCTAC
TCCCAACATCAGCCGGACTCCGATTACCTCGGGAACCTTGCTCCGTAGTAAGACATTCATC
GCGCTTGCTGCCTTCGACCAAGAAGCGGTTGTTGGCGCTCTCGCGGCTTACGTTCTGCCC
AGGTTTGAGCAGCCGCGTAGTGAGATCTATATCTATGATCTCGCAGTCTCCGGCGAGCAC
CGGAGGCAGGGCATTGCCACCGCGCTCAATCTCCTCAAGCATGAGGCCAACGCGCTT
GGTGCTTATGTGATCTACGTGCAAGCAGATTACGGTGACGATCCCGCAGTGGCTCTCTAT
ACAAAGTTGGGCATACGGGAAGAAGTGATGCACCTTGATATCGACCCAAGTACCGCCACC
TAACAATTCTGTTCAAGCCGAGATCGGCTTCCCGGCCTAATAGGTTGTATTGATGTTGGAC
GAGTCGGAATCGCAGACCGATACCAGGATCTTGCCATCCTATGGAAGTGCCTCGGTGAGT
TTTCTCCTTCATTACAGAAACGGCTTTTCAAAAATATGGTATTGATAATCCTGATATGA
ATAAATTGCAGTTTTCATTGATGCTCGATGAGTTTTTCTAATCAGAATTGGTTAATTGGT
TGTAACACTGGCAGAGCATTACGCTGACTTGACGGGACGGCGNCATGACCAAAATCCCTT
AACGTGAGTTTTTCGTTCCACTGAGCGTCAGACCCCGTAGAAAAGATCAAAGGATCTTCTT
GAGATCCTTTTTTCTGCGCGTAATCTGCTGCTTGCAAACAAAAAACCCGCTACCCAG
CGGTGGTTTGTGTTGCCGATCAAGAGCTACCAACTCTTTTTCCGAAGGTAAGTGGCTTCA
GCAGAGCGCAGATACCAATACTGTCCTTCTAGTGAGCCGTAGTTAGGCCACCACTTCA
AGAACTCTGTAGCACCGCCTACATACCTCGCTCTGCTAATCCTGTTACCAGTGGCTGCTG
CCAGTGGCGATAAGTCGTGTCTTACCGGGTTGGACTCAAGACGATAGTTACCGGATAAGG
CGCAGCGGTGCGGCTGAACGGGGGGTTCGTGCACACAGCCCAGCTTGGAGCGAACGACCT
ACACCGAACTGAGATACCTACAGCGTGAGCATTGAGAAAGCGCCACGCTTCCCGAAGGGA
GAAAGGCGGACAGGTATCCGGTAAGCGGCAGGGTCGGAACAGGAGAGCGCACGAGGGAGC
TTCCAGGGGGGAACGCCTGGTATCTTTATAGTCTGTGCGGTTTCGCCACCTCTGACTTG
AGCGTCGATTTTTGTGATGCTCGTCAGGGGGGCGAGCCTATGGA AAAACGCCAGCAACG
CGGCTTTTACGGTTCTTGCCCTTTTGCTGGCCTTTTGCTCACATGTTCTTTCTGCGT
TATCCCTTGATCTGTGGATAACCGTATTACCGCCTTTGAGTGAGCTGATACCGCTCGCC
GCAGCCGAACGAGCGCAGCGAGTCAGTGAGCGAGGAAGCGGAAGAGCGCCCAATAC
GCAAACCGCCTCTCCCGCGCGTGGCCGATTATTAATGCAGCTGGCAGCACAGGTTTC
CCGACTGGAAGCGGGCAGTGAGCGCAACGCAATTAATGTGAGTTACCTCACTCATTAGG
CACCCAGGCTTTACACTTTATGCTTCCGGCTCCTATGTTGTGTGGAATTGTGAGCGGAT
ACAATTTACACAGGAAACAGCTATGACCATGATTACGCCAAGCTCGGAATTAACCTC-

FIGURE 94B

ACTAAAGGGAACAAAAGCTGGTACCGATCCCGAGCTTTGCAAATTAAAGCCTTCGAGCGT
CCCCAAACCTTCTCAAGCAAGGTTTTTCAAGTATAATGTTACATGCGTACACGCGTCTGTAC
AGAAAAAAGAAAAATTTGAAATATAAATAACGTTCTTAATACTAACATAACTATAAAA
AAATAAATAGGGACCTAGACTTCAGGTTGTCTAACTCCTTCCTTTTCGGTTAGAGCGGAT
GTGGGGGGAGGGCGTGAATGTAAGCGTGACATAACTAATTACATGATATCGACAAAAGGAA
AAGGGGCTGTTTACTCACAGGCTTTTTTCAAGTAGGTAATTAAAGTCGTTTCTGTCTTTT
TCCTTCTTCAACCCACCAAAGGCCATCTTGGTACTTTTTTTTTTTTTTTTTTTTTTTTTT
TT
TTTTTTTTCATAGAAATAATACAGAAGTAGATGTTGAATTAGATTAACTGAAGATATAT
AATTTATTGGAATAACATAGAGCTTTTTGTTGATGCGCTTAAGCGATCAATTCACAAC
ACCACCAGCAGCTCTGATTTTTTCTTCAGCCAACCTGGAGACGAATCTAGCTTTGACGAT
AACTGGAACATTTGGAATTCTACCCTTACCCAAGATCTTACCGTAACCGGCTGCCAAAGT
GTCAATAACTGGAGCAGTTTCTTAGAAGCAGATTTCAAGTATTGGTCTCTCTGTCTTC
TGGGATCAATGTCCACAATTTGTCCAAGTTCAAGACTGGCTTCAGAAATGAGCTTGTG
CTTGTGGAAGTATCTCATACCAACCTTACCGAAATAACCTGGATGGTATTTATCCATGTT
AATCTGTGGTATGTTGACCAACCGCCATACCTCTACCACCGGGGTGCTTTCTGTGCTT
ACCGATACGACCTTTACCGCTGAGACGTGACCTCTGTGCTTTCTAGTCTTAGTGAATCT
GGAAGGCATTCTTGATTAGTTGGATGATTGTTCTGGGATTTAATGCAAAAATCACTTAAG
AAGGAAATCAACGGAGAAAGCAAACGCCATCTTAAATATACGGGATACAGATGAAAGGG
TTTGAACCTATCTGGAATAAGCATTAAACAAGCGAAAACTGCGAGGAAAAATGTTTGC
GTCTCTGCGGGCTATTACGCGCCAGAGGAAAAATAGGAAAAATAACAGGGCATTAGAAAA
ATAATTTTGATTTTGGTAATGTGTGGGTCTGGTGTACAGATGTTACATTGGTTACAGTA
CTCTTGTTTTTGCTGTGTTTTTCGATGAATCTCCAAAATGGTTGTTAGCACATGGAAGAG
TCACCGATGCTAAGTTATCTCTATGTAAGTACGTGGCGTGACTTTTGATGAAGCCGCAC
AAGAGATACAGGATTGGCAACTGCAATAGAACTCTGGGGATCCCCCTCGAGATCCGGGA
TCGAAGAAATGATGGTAAATGAAATAGGAAATCAAGGAGCATGAAGGCAAAAGACAAATA
TAAGGGTCGAACGAAAAATAAGTGAAAAGTGTTGATATGATGATTTGGCTTTGCGGCG
CCGAAAAAACGAGTTTACGCAATTGCACAATCATGCTGACTCTGTGGCGGACCCGCGCTC
TTGCGGCGCCGCGGATAACGCTGGGCGTGAGGCTGTGCCCCGGCGGAGTTTTTTGCGCCTG
CATTTTCCAAGGTTTACCCTGCGCTAAGGGGCGAGATTGGAGAAGCAATAAGAATGCCGG
TTGGGGTTGCGATGATGACGACCACGACAACCTGGTGTCAATTATTTAAGTTGCCGAAAGAA
CCTGAGTGCAATTTGCAACATGAGTATACTAGAAGAATGAGCCAAGACTTGCAGACGCGA
GTTTGCCGGTGGTGCGAACAATAGAGCGACCATGACCTTGAAGGTGAGACGCGCATAACC
GCTAGAGTACTTTGAAGAGGAAACAGCAATAGGGTTGCTACCAGTATAAATAGACAGGTA
CATACAACACTGGAAATGTTGTCTGTTGAGTACGCTTTCAATTCATTTGGGTGTGCAC
TTTATTATGTTACAATATGGAAGGGAACTTTACACTTCTCCTATGCACATATATTAATTA
AAGTCCAATGCTAGTAGAGAAGGGGGTAACACCCCTCCGCGCTCTTTCCGATTTTTTTT
CTAAACCGTGGAATATTTCCGATATCCTTTTGTGTTTCCGGGTGTACAATATGGACTTC
CTCTTTTCTGGCAACCAAACCCATACATCGGGATTCTTATAATACCTTCGTTGGTCTCCC
TAACATGTAGGTGGCGGAGGGGAGATATACAATAGAACAGATACCAGACAAGACATAATG
GGCTAAACAAGACTACACCAATTACACTGCCTCATTTGATGGTGGTACATAACGAACATAAT
ACTGTAGCCCTAGACTTGATAGCCATCATCATATCGAAGTTTCACTACCCTTTTCCATT
TGCCATCTATTGAAGTAATAATAGGCGCATGCAACTTCTTTTCTTTTTTTTTTCTTTCTC
TCTCCCCGTTGTTGTCTCACCATATCCGCAATGACAAAAAATGATGGAAGACACTAA
AGGAAAAAATTAACGACAAAGACAGCACCAACAGATGTCGTTGTTCCAGAGCTGATGAGG
GGTATCTTCGAACACACGAACTTTTTCTTCTTCTTCAATCACGCACACTACTCTCTAATG
AGCAACGGTATACGGCCTTCTTCCAGTTACTTGAATTTGAAATAAAAAAGTTTGCCGC
TTTGCTATCAAGTATAAATAGACCTGCAATTATTAATCTTTTGTTCCTCGTCATTGTTT
TCGTTCCCTTTCTTCTTGTCTTTTTCTGCACAATATTTCAAGCTATACCAAGCATAAC
AATCAACTCCAAGCTTGAAGCAAGCCTCCTGAAAGATGAAGCTACTGTCTTCTATCGAAC
AAGCATGCGATATTTGCCGACTTAAAAGCTCAAGTGCTCCAAAGAAAAACCGAAGTGCG
CCAAGTGCTGAAGAACAACCTGGGAGTGTCGCTACTCTCCCAAACCAAAAGGTCTCCGC
TGACTAGGGCACATCTGACAGAAGTGAAGTCAAGGCTAGAAAGACTGGAACAGCTATTTT
TACTGATTTTTCTCGAGAAGACCTTGACATGATTTTGAAAATGGATTCTTTACAGGATA
TAAAAGCATTGTTAACAGGATTATTTGTACAAGATAATGTGAATAAAGATGCCGTCACAG
ATAGATTGGCTTCAGTGGAGACTGATATGCCTCTAACATTGAGACAGCATAGAATAAGTG
CGACATCATCATCGGAAGAGAGTAGTAACAAAGGTCAAAGACAGTTGACTGTATCGTCGA
GGTCGAATCAAACAAGTTTGTACAAAAAGCTGAACGAGAAACGTAAATGATATAAATA-

Figure 94C

TCAATATATTAAATTAGATTTTGCATAAAAAACAGACTACATAATACTGTAAAACACAAC
ATATCCAGTCACTATGGCGGCCGCTAAGTTGGCAGCATCACCCGACGCACTTTGCGCCGA
ATAAATACCTGTGACGGAAGATCACTTCGAGAATAAAATAAATCCTGGTGTCCCTGTTGA
TACCGGGAAGCCCTGGGCCAAGTTTGGCGAAAATGAGACGTTGATCGGCACGTAAGAGG
TTCCAAGCTTTCACCATAATGAAATAAGATCACTACCGGGCGTATTTTTTTGAGTTATCGAG
ATTTTTCAGGAGCTAAGGAAGCTAAAATGGAGAAAAAAATCACTGGATATACCACCGTTGA
TATATCCCAATGGCATCGTAAAGAACATTTTGGAGGCATTCAGTCAGTTGCTCAATGTAC
CTATAACCAGACCGTTTACGCTGGATATTACGGCCTTTTAAAGACCGTAAAGAAAAATAA
GCACAAGTTTTATCCGGCCTTTATTACATTTCTTGCCCGCTGATGAATGCTCATCCGGA
ATTCCGTATGGCAATGAAAGACGGTGAGCTGGTGATATGGGATAGTGTTACCCCTTGTTA
CACCGTTTTCCATGAGCAAAGTGAACGTTTTTCATCGCTCTGGAGTGAATACCACGACGA
TTTCCGGCAGTTTCTACACATATATTCGCAAGATGTGGCGTGTTACGGTGAAAACCTGGC
CTATTTCCCTAAAGGGTTTATTGAGAATATGTTTTCTGCTCTCAGCCAATCCCTGGGTGAG
TTTACCAGTTTTGATTTAAACGTGGCCAATATGGACAACCTTCTTCGCCCCCGTTTTTCAC
CATGGGCAAATATTATACGCAAGGCGACAAGGTGCTGATGCCGCTGGCGATTTCAGGTTCA
TCATGCCGCTCTGTGATGGCTTCCATGTCCGCGAGAATGCTTAATGAATTACAACAGTACTG
CGATGAGTGGCAGGGCGGGCGTAATCTAGAGGATCCGGCTTACTAAAAGCCAGATAACA
GTATGCGTATTTGCGCGCTGATTTTGGCGGTATAAGAATATATACTGATATGTATACCCG
AAGTATGTCAAAAAGAGGTGTGCTATGAAGCAGCGTATTACAGTGACAGTTGACAGCGAC
AGCTATCAGTTGCTCAAGGCATATATGATGTCAATATCTCCGGTCTGGTAAGCACAACCA
TGCAGAAATGAAGCCCGTCTGCTGCGTGCCGAACGCTGGAAAGCGGAAAATCAGGAAGGGA
TGGCTGAGGTCCGCCGTTTATTGAAATGAACGGCTCTTTTGCTGACGAGAACAGGACT
GGTGAAATGCAGTTTAAAGGTTTACACCTATAAAAGAGAGAGCCGTTATCGTCTGTTTGTG
GATGTACAGAGTGATATTATTGACACGCCCGCGACGGATGGTGATCCCCCTGGCCAGT
GCACGTCTGCTGTCAGATAAAGTCTCCCGTGAACTTTACCCGGTGGTGCATATCGGGGAT
GAAAGCTGGCGCATGATGACCACCGATATGGCCAGTGTGCCGCTCTCCGTTATCGGGGAA
GAAGTGGCTGATCTCAGCCACCGCGAAAATGACATCAAAAACGCCATTAACCTGATGTTT
TGGGGAATATAAATGTGAGGCTCCCTTATACACAGCCAGTCTGCAGGTGACCATAGTGA
CTGGATATGTTGTGTTTTACAGTATTATGTAGTCTGTTTTTTATGCAAAATCTAATTTAA
TATATTGATATTTATATCATTTTACGTTTCTCGTTTCTGTTTCTGTACAAAGTGGTTTG
ATGGCCGCTAAGTAAGTAAGACGTCGAGCTCTAAGTAAGTAACGGCCGCCACCGCGGTG
AGCTTTGGACTTCTTCGCCAGAGGTTTGGTCAAGTCTCCAATCAAGGTTGTGCGCTTGTG
TACCTTGGCAGAAATTTACGAAAAGATGGAAAAGGGTCAAATCGTTGGTAGATACGTTGT
TGACACTTCTAAATAAGCGAATTTCTTATGATTTATGATTTTTATTATTAAATAAGTTAT
AAAAAAATAAGTGTATACAAATTTTAAAGTGACTCTTAGGTTTTAAAACGAAAATTCTT
GTTCTTGAGTAACCTCTTCTGTAGGTGAGTTGCTTTCTCAGGTATAGCATGAGGTGCG
TCTTATTGACCACACCTCTACCGGCATGCCGAGCAAATGCCTGCAAATCGCTCCCCATT
CACCCAATTGTAGATATGCTAACTCCAGCAATGAGTTGATGAATCTCGGTGTGATTTTA
TGTCCTCAGAGGACAATACCTGTTGTAATCGTTCTTCCACACGGATCCCAATTCGCCCTA
TAGTGAGTCGTATTACAATTCAGTGGCCGTCGTTTTACAACGTCGTGACTGGGAAAACCC
TGGCGTTACCCAACTTAATCGCCTTGACGACATCCCCCTTTCGCCAGCTGGCGTAATAG
CGAAGAGGCCCGCACCGATCGCCCTTCCCAACAGTTGCGCAGCCTGAATGGCGAATGGAC
GCGCCCTGTAGCGGCGCATTAAGCGCGCGGGTGTGGTGGTTACGCGCAGCGTGACCGCT
ACACTTGCCAGCGCCCTAGCGCCCGCTCCTTTGCTTTCTTCCCTTCTTTCTCGCCACG
TTCGCCGCTTTCCCCGTCAAGCTCTAAATCGGGGGCTCCCTTTAGGGTCCGATTTAGT
GCTTTACGGCACCTCGACCCCAAAAACTTGATTAGGGTGATGGTTACGTTAGTGGGCCA
TCGCCCTGATAGACGGTTTTTTCGCCCTTTCAGCTTGGAGTCCACGTTCTTTAATAGTGGA
CTCTTGTTCCAACTGGAACAACACTCAACCCTATCTCGGTCTATTCTTTGATTTATAA
GGGATTTTGCCGATTTTCGGCCTATTGGTTAAAAAATGAGCTGATTTAACAAAAATTTAAC
GCGAATTTTAAACAAAATATTAAAGTTTACAATTTCTGATGCGGTATTTTCTCCTTACGC
ATCTGTGCGGTATTTACACCGCATATCGACCGGTGAGGAGAACTTCTAGTATATCCAC
ATACCTAATATTATTGCTTATTAAAAATGGAATCGGAACAATTACATCAAAATCCACAT
TCTCTTCAAAATCAATTGTCTGTACTTCTTGTTCATGTGTGTTCAAAAACGTTATATT
TATAGGATAATTATACTCTATTTCTCAACAAGTAATTGGTTGTTTGGCCGAGCGGTCTAA
GGCGCCTGATTCAAGAAATATCTTGACCGCAGTTAACTGTGGGAATACTCAGGTATCGTA
AGATGCAAGAGTTGAAATCTCTTAGCAACCATTATTTTTTCTCAACATAACGAGAACA
CACAGGGGCGCTATCGCACAGAATCAAATTCGATGACTGGAAATTTTTTGTTAATTTAG
AGGTGCGCTGACGCATATACCTTTTTCACTGAAAAATTTGGGAGAAAAAGGAAAGGTGAG-

FIGURE 94D

222/240

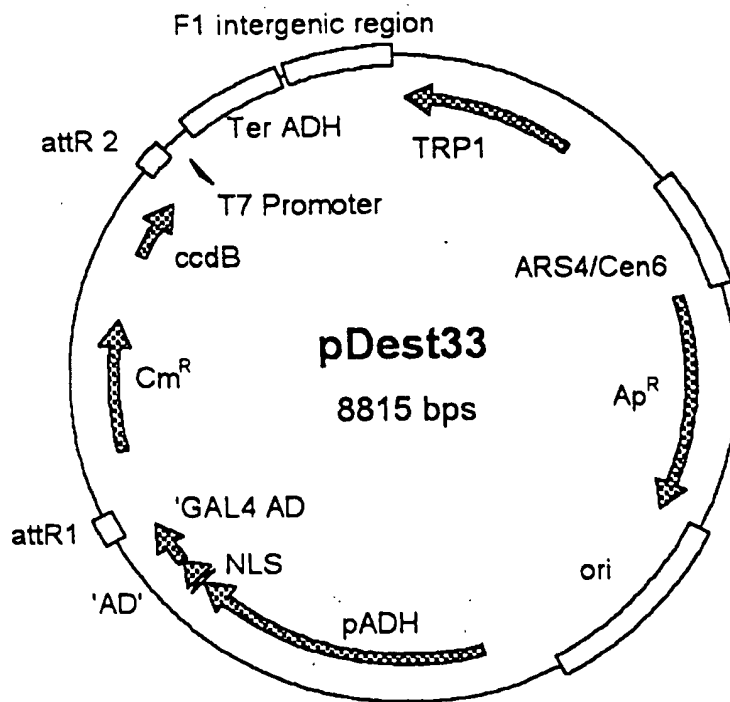


FIGURE 95A

pDEST33 8815 bp

GCCTTACGCATCTGTGCGGTATTTACACCCGAGGCAAGTGCACAAACAATACTTAAATA
AATACTACTCAGTAATAACCTATTTCTTAGCATTTTGTGACGAAATTGCTATTTTGTAG
AGTCTTTTACACCATTGTCTCCACACCTCCGCTTACATCAACACCAATAACGCCATTTA
ATCTAAGCGCATCACCAACATTTTCTGGCGTCAGTCCACCAGCTAACATAAAATGTAAGC
TTTCGGGGCTCTCTTGCCCTTCCAACCCAGTCAGAAATCGAGTTCCAATCCAAAAGTTCAC
CTGTCCCACCTGCTTCTGAATCAAACAAGGGAATAAACGAATGAGGTTTCTGTGAAGCTG
CACTGAGTAGTATGTTGCAGTCTTTTGGAAATACGAGTCTTTTAATAACTGGCAAACCGA
GGAACCTTGGTATTCTTGCCACGACTCATCTCCATGCAGTTGGACGATATCAATGCCGT
AATCATTGACCAGAGCCAAAACATCCTCCTTAGGTTGATTACGAAACACGCCAACCAAGT
ATTTCCGGAGTGCCTGAACTATTTTATATGCTTTTACAAGACTTGAAATTTTCTTGCAA
TAACCGGGTCAATTGTTCTCTTTCTATTGGGCACACATATAATACCCAGCAAGTCAGCAT
CGGAATCTAGAGCACATTCTGCGGCTCTGTGCTCTGCAAGCCGCAAACCTTTCACCAATG
GACCAGAATACTACCTGTGAAATTAATAACAGACATACTCCAAGCTGCCTTTGTGTGCTTAA
TCACGTATACTCACGTGCTCAATAGTCACCAATGCCCTCCCTCTTGCCCTCTCCTTTTC
TTTTTTCGACCGAATTAATTCTTAATCGGCAAAAAAAGAAAAGCTCCGGATCAAGATTGT
ACGTAAGGTGACAAGCTATTTTCAATAAAGAATATCTTCCACTACTGCCATCTGGCGTC
ATAACTGCAAAGTACACATATATTACGATGCTGTCTATTAAATGCTTCCTATATTATATA
TATAGTAATGTGCTTTATGGTGCACCTCTCAGTACAATCTGCTCTGATGCCGCATAGTTAA
GCCAGCCCCGACACCCGCCAACACCCGCTGACGCGCCCTGACGGGCTTGTCTGCTCCCGG
CATCCGCTTACAGACAAGCTGTGACCGTCTCCGGGAGCTGCATGTGTGAGAGTTTTCAC
CGTCATACCGAAACGCGCGAGACGAAAGGGCCTCGTGATACGCCTATTTTATAGTTTAA
ATGTCATGATAATAATGGTTTCTTAGGACGGATCGCTTGCCTGTAACCTTACACGCGCCTC
GTATCTTTTAAATGATGGAATAATTTGGGAATTTACTCTGTGTTTATTTATTTTATGTTT
TGTATTTGGATTTTAGAAAGTAAATAAAGAAGGTAGAAGAGTTACGGAATGAAGAAAAA
AAATAAACAAAGGTTTAAAAAATTTCAACAAAAAGCGTACTTTACATATATATTTATTAG
ACAAGAAAAGCAGATTAAATAGATATACATTGATTAACGATAAGTAAATGTAAATCA
CAGGATTTTTCGTGTGTGGTCTTCTACACAGACAAGATGAAACAATTCCGGCATTAAACCT
GAGAGCAGGAAGAGCAAGATAAAAGGTAGTATTTGTTGGCGATCCCCCTAGAGTCTTTTA
CATCTTCGGAAAACAAAACTATTTTCTTAAATTTCTTTTCTTACTTTCTATTTTAA
TTTATATATTTATATTAATAAATTTAAATTATAATTATTTTATAGCACGTGATGAAAG
GACCCAGGTGGCACTTTTTCGGGGAATGTGCGCGGAACCCCTATTTGTTTATTTTCTAA
ATACATTCAAATATGTATCCGCTCATGAGACAATAACCCTGATAAATGCTTCAATAATAT
TGAAAAAGGAAGAGTATGAGTATTCACATTTCCGTGTGCGCCTTATTCCCTTTTTTTCG
GCATTTTGCCTTCCTGTTTTTGCTCACCCAGAAACGCTGGTGAAAGTAAAGATGCTGAA
GATCAGTTGGGTGCACGAGTGGGTTACATCGAAGTGGATCTCAACAGCGGTAAGATCCTT
GAGAGTTTTTCGCCCCGAAGAACGTTTTTCCAATGATGAGCACTTTTAAAGTCTGCTATGT
GGCGCGGTATTATCCCGTATTGACGCCGGGCAAGAGCAACTCGGTGCGCCGCATACACTAT
TCTCAGAATGACTTGGTTGAGTACTCACCAGTCACAGAAAAGCATCTTACGGATGGCATG
ACAGTAAGAGAATTATGCAGTGTCTGCCATAACCATGAGTGATAACACTGCGGCCAACTTA
CTTCTGACAACGATCGGAGGACCGAAGGAGCTAACCGCTTTTTTTCACAACATGGGGGAT
CATGTAACTCGCCTTGATCGTTGGGAACCGGAGCTGAATGAAGCCATAACCAACGACGAG
CGTGACACCACGATGCCTGTAGCAATGGCAACAACGTTGCGCAAACTATTAAGTGGCGAA
CTACTTACTCTAGCTTCCCGGCAACAATTAATAGACTGGATGGAGGCGGATAAAGTTGCA
GGACCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTATTGCTGATAAATCTGGAGCC
GGTGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCAGATGGTAAGCCCTCCCGT
ATCGTAGTTATCTACACGACGGGCAGTCAGGCAACTATGGATGAACGAAATAGACAGATC
GCTGAGATAGGTGCCTCACTGATTAAAGCATTTGGTAACTGTCAGACCAAGTTTACTCATAT
ATACTTTAGATTGATTTAAAACTTCATTTTAAATTTAAAGGATCTAGGTGAAGATCCTT
TTTGATAATCTCAGTACCAAAATCCCTTAACGTGAGTTTTCGTTCCACTGAGCGTCAGAC
CCCGTAGAAAAGATCAAAGGATCTTCTTGAGATCCTTTTTTTCTGCGCGTAATCTGCTGC
TTGCAAAACAAAAAACACCGCTACCAGCGGTGGTTTGTGTTGCCGGATCAAGAGCTACCA
ACTCTTTTCCGAAGGTAAGTGGCTTCAGCAGAGCGCAGATACCAAATACTGTCTTCTA
GTGTAGCCGTAGTTAGGCCACCACTTCAAGAACTCTGTAGCACCGCCTACATACCTCGCT
CTGCTAATCCTGTTACAGTGGCTGCTGCCAGTGGCGATAAGTCGTGTCTTACCGGGTTG
GACTCAAGACGATAGTTACCGGATAAGGCGCAGCGGTGCGGCTGAACGGGGGGTTCGTGC
ACACAGCCCAGCTTGGAGCGAACGACCTACACCGAACTGAGATACCTACAGCGTGAGCAT-

FIGURE 95B

224/260

TGAGAAAGCGCCACGCTTCCCGAAGGGAGAAAGGCGGACAGGTATCCGGTAAGCGGCAGG
GTCGGAACAGGAGAGCGCACGAGGGAGCTTCCAGGGGGGAACGCCTGGTATCTTTATAGT
CCTGTGCGGTTTTCGCCACCTCTGACTTGAGCGTCGATTTTTGTGATGCTCGTCAGGGGGG
CCGAGCCTATGGAAAAACGCCAGCAACGCGGCCTTTTTACGGTTCCTGGCCTTTTGCTGG
CCTTTTGCTCACATGTTCTTTCTGCGTTATCCCTGATTCTGTGGATAACCGTATTACC
GCCTTTGAGTGAGCTGATACCGCTCGCCGACCCGAACGACCGAGCGCAGCGAGTCAGTG
AGCGAGGAAGCGGAAGAGCGCCCAATACGCAAAACCGCCTCTCCCCGCGCGTTGGCCGATT
CATTAATGTCAGCTGGCAGACAGGTTTTCCGACTGGAAAGCGGCAGTGAGCGCAACGCA
ATTAATGTGAGTTACCTCACTCATTAGGCACCCAGGCTTTACACTTTATGCTTCCGGCT
CCTATGTTGTGTGGAATTGTGAGCGGATAACAATTTACACAGGAAACAGCTATGACCAT
GATTACGCCAAGCTCGGAATTAACCCTCACTAAAGGGAACAAAAGCTGGGTACCGGGCCC
CCCCTCGAGATCCGGGATCGAAGAAATGATGGTAAATGAAATAGGAAATCAAGGAGCATG
AAGGCAAAAGACAAATATAAGGGTCGAACGAAAAATAAAGTGAAAAGTGTTGATATGATG
TATTTGGCTTTGCGGCGCCGAAAAACGAGTTTACGCAATTGCACAATCATGCTGACTCT
GTGGCGGACCCGCGCTCTTGCCGGCCCCGGCGATAACGCTGGGCGTGAGGCTGTGCCGGC
GGAGTTTTTTGCGCCTGCATTTTCCAAGGTTTACCCTGCGCTAAGGGGCGAGATTGGAGA
AGCAATAAGAATGCCGTTTGGGGTTGCGATGATGACGACCAGCAACTGGTGTCTATTAT
TTAAGTTGCCGAAAGAACCTGAGTGCATTTGCAACATGAGTATACTAGAAGAATGAGCCA
AGACTTGCGAGACGCGAGTTTGCCGGTGGTGCGAACAATAGAGCGACCATGACCTTGAAG
GTGAGACGCGCATAACCGCTAGAGTACTTTGAAGAGGAAACAGCAATAGGGTTGCTACCA
GTATAAATAGACAGGTACATAACAACACTGGAAATGGTTGTCTGTTTGAGTACGCTTTCAA
TTCATTTGGGTGTGCACTTTATTATGTTACAATATGGAAGGGAACCTTTACACTTCTCCTA
TGCACATATATTAATTAAGTCCAATGCTAGTAGAGAAGGGGGGTAAACACCCCTCCGCGC
TCTTTTCCGATTTTTTTCTAAACCGTGGAATATTTTCGGATATCCTTTTGTGTTTCCGGG
TGTACAATATGGACTTCTCTTTCTGGCAACCAACCCATACATCGGGATTCTCTATAAT
ACCTTCGTTGGTCTCCCTAACATGTAGGTGGCGGAGGGGAGATATACAATAGAACAGATA
CCAGACAAGACATAAATGGGCTAAACAAGACTACACCAATTACACTGCCTCATTGATGGTG
GTACATAACGAATAATACTGTAGCCCTAGACTTGATAGCCATCATCATATCGAAGTTTC
ACTACCCTTTTTCCATTTGCCATCTATTGAAGTAATAATAGGCGCATGCAACTTCTTTTC
TTTTTTTTTCTTTCTCTCTCCCCGTTGTTGTCTCACCATATCCGCAATGACAAAAAA
ATGATGGAAGACACTAAAGGAAAAAATTAACGACAAAGACAGCACCAACAGATGTCGTTG
TTCCAGAGCTGATGAGGGGTATCTTCGAACACACGAACTTTTCTTCTCTTCACTTACG
CACACTACTCTCTAATGAGCAACGGTATACGGCCTTCTTCCAGTTACTTGAATTTGAAA
TAAAAAAAGTTTGCCGCTTTGCTATCAAGTATAAATAGACCTGCAATTATTAATCTTTTG
TTTCTCGTCAATTGTTCTCGTTCCCTTTCTTCTTGTGTTCTTTTTCTGCACAATATTTCA
AGCTATACCAAGCATACAATCAACTCCAAGCTTATGCCCAAGAAGAAGCGGAAGGTCTCG
AGCGGCGCCAATTTAATCAAAGTGGAATATTGCTGATAGCTCATTGTCTTCACTTTC
ACTAACAGTAGCAACGGTCCGAACCTCATAACAACCTCAAACAAATTCTCAAGCGCTTTC
CAACCAATTGCCTCCTCTAACGTTTCATGATACTTTCATGAATAATGAAATCACGGCTAGT
AAAATTGATGATGGTAATAATTCAAACCACTGTACCTGGTTGGACGGACCAAACTGCG
TATAACGCGTTTGGAACTACTACAGGGATGTTAATAACCACTACAATGGATGATGTATAT
AACTATCTATTGATGATGAAGATACCCCAACCAACCAAAAAAGAGGGTGGGTGGAAT
CAAACAAGTTTGTACAAAAAGCTGAACGAGAAACGTAAATGATATAAATATCAATATA
TTAAATTAGATTTTGCATAAAAAACAGACTACATAAATACTGTAAAAACACAACATATCCAG
TCACTATGGCGGCGCTAAGTTGGCAGCATCACCCGACGCACTTTGCGCCGAATAAATAC
CTGTGACGGAAGATCACTTCGCGAGAATAAATAAATCCTGGTGTCCCTGTTGATACCGGGA
AGCCCTGGGCCAACTTTTGGCGAAAATGAGACGTTGATCGGCACGTAAGAGGTTCCAAC
TTCACCATAATGAAATAAGATCACTACCGGGCGTATTTTTTGTGATTATCGAGATTTTCAG
GAGCTAAGGAAGCTAAATGGAGAAAAAATCACTGGATATAACCACGTTGATATATCCC
AATGGCATCGTAAAGAACATTTTGGAGGCACTTCAGTCAGTTGCTCAATGTACCTATAACC
AGACCGTTTCAGCTGGATATTACGGCCTTTTTTAAAGACCGTAAAGAAAAATAAGCACAAGT
TTTATCCGGCCTTTATTCACATTCTTGCCCGCCTGATGAATGCTCATCCGGAATCCGTA
TGGCAATGAAAGACGGTGAGCTGGTATGAGGATAGTGTTCACCCTTGTTACACCGTTT
TCCATGAGCAAACTGAAACGTTTTCATCGCTCTGGAGTGAATACCACGACGATTTCCGGC
AGTTTCTACACATATATTGCAAGATGTGGCGTGTTACGGTGAAAACCTGGCCTATTTCC
CTAAAGGGTTTATTGAGAATATGTTTTTCTGCTCAGCCAATCCCTGGGTGAGTTTCACCA
GTTTTGATTTAAACGTGGCCAATATGGACAACCTCTTCGCCCCCGTTTTTCACCATGGGCA
AATATTATACGCAAGGCGACAAGGTGCTGATGCCGCTGGCGATTTCAGGTTTCATCATGCCG-

FIGURE 95C

TCTGTGATGGCTTCCATGTCCGGCAGAAATGCTTAATGAATTACAACAGTACTGCGATGAGT
GGCAGGGCGGGGCGTAATCTAGAGGATCCGGCTTACTAAAAGCCAGATAACAGTATGCGT
ATTTGCGCGCTGATTTTTGCGGTATAAGAATATATACTGATATGTATACCCGAAGTATGT
CAAAAAGAGGTGTGCTATGAAGCAGCGTATTACAGTGACAGTTGACAGCGACAGCTATCA
GTTGCTCAAGGCATATATGATGTCAATATCTCCGGTCTGGTAAGCACCAACCATGCAGAAT
GAAGCCCGTCGTCTGCGTGCCGAACGCTGGAAAGCGGAAAATCAGGAAGGGATGGCTGAG
GTCGCCCCGTTTTATTGAAATGAACGGCTCTTTTGCTGACGAGAACAGGGACTGGTGAAAT
GCAGTTTAAAGTTTACACCTATAAAAGAGAGAGCCGTTATCGTCTGTTTGTGGATGTACA
GAGTGATATTATTGACACGCCCCGGGCGACGGATGGTGATCCCCCTGGCCAGTGCACGTCT
GCTGTGATATAAAGTCTCCCGTGAACCTTTACCCGGTGGTGATATCGGGGATGAAAGCTG
GCGCATGATGACCACCGATATGGCCAGTGTGCCGGTCTCCGTTATCGGGGAAGAAGTGGC
TGATCTCAGCCACCGCGAAAATGACATCAAAAACGCCATTAACCTGATGTTCTGGGGAAT
ATAAATGTCTAGGCTCCGTTATACACAGCCAGTCTGCAGGTCGACCATAGTGACTGGATAG
GTTGTTGTTTTACAGTATTATGTAGTCTGTTTTTTATGCAAAATCTAATTTAATATATTGA
TATTTATATCATTTTACGTTTTCTCGTTTCTGTTTCTTGTACAAAGTGGTTTTGATGGCCGC
TAAGTAAGTAAGACGTGAGCTCCCTATAGTGAGTCGTATTACACTGGCCGTCGTTTTAC
AACGTCGTGACTGGGAAAACACCGGTGAGCTCTAAGTAAGTAACGGCCGCCACCGCGGTG
GAGCTTTGGACTTCTTCGCCAGAGGTTTGGTCAAGTCTCCAATCAAGGTTGTGCGCTTGT
CTACCTTGCCAGAAATTTACGAAAAGATGGAAAAGGGTCAAATCGTTGGTAGATACGTTG
TTGACACTTCTAAATAAGCGAATTTCTTATGATTTATGATTTTTATTATTAAATAAGTTA
TAAAAAAATAAGTGTATACAAATTTTAAAGTGAATCTTAGGTTTTAAAACGAAAATTCT
TGTTCTTGAGTAACTCTTTCCTGTAGGTGAGGTTGCTTCTCAGGTATAGCATGAGGTCG
CTCTTATTGACCACACCTCTACCGGCATGCCGAGCAAATGCCTGCAAATCGCTCCCCATT
TCACCCCAATTGTAGATATGCTAACTCCAGCAATGAGTTGATGAATCTCGGTGTGATTTT
ATGTCCTCAGAGGACAATACCTGTTGTAATCGTTCTTCCACACGGATCCGCATCAGGCGA
AATTGTAAACGTTAATATTTTGTAAATTCGCGTTAAATATTTGTTAAATCAGCTCATT
TTTTAACCAATAGGCCGAAATCGGCAAAATCCCTTATAAATCAAAGAATAGACCGAGAT
AGGGTTGAGTGTTGTTCCAGTTTGGAACAAGAGTCCACTATTAAAGAACGTGGACTCCAA
CGTCAAAGGGCGAAAAACCGTCTATCAGGGCGATGGCCCACTACGTGAACCATCACCTA
ATCAAGTTTTTTTGGGGTTCGAGGTGCCGTAAAGCACTAAATCGGAACCCTAAAGGGAGCCC
CCGATTTAGAGCTTGACGGGGAAAGCCGGCGAACGTGGCGAGAAAGGAAGGAAGAAAGC
GAAAGGAGCGGGCGCTAGGGCGCTGGCAAGTGTAGCGGTACGCTGCGCGTAACCACCAC
ACCCGCCGCGCTTAATGCGCCGCTACAGGGCGCGTCCCATTCGCCATTCACTGCA

FIGURE 95D

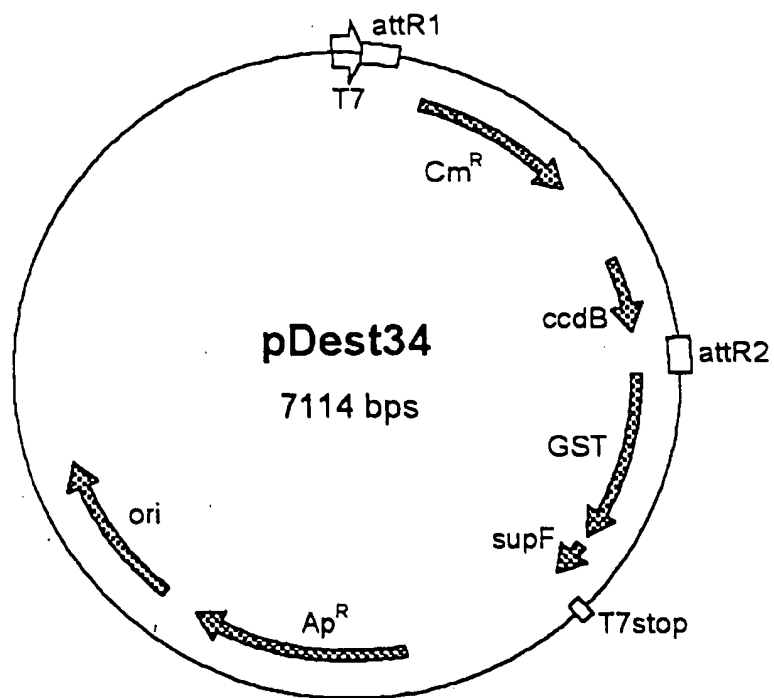


FIGURE 96A

pDEST34 7114 bp

<u>Location (Base Nos.)</u>	<u>Gene Encoded</u>
195..71	attR1
304..963	CmR
1305..1610	ccdB
1651..1775	attR2
1780..2472	GST
2675..2720	T7stop
3334..4194	ampR
4343..4982	ori

ATCGAGATCTCGATCCCGCGAAATTAATACGACTCACTATAGGGAGACCACAACGGTTTC
 CCTCTAGATCACAAGTTTGTACAAAAAGCTGAACGAGAAACGTAAATGATATAAATAT
 CAATATATTAAATTAGATTTTGCATAAAAAACAGACTACATAATACTGTAAACACAACA
 TATCCAGTCACTATGGCGGCCGCATTAGGCACCCCAGGCTTTACACTTTATGCTTCCGGC
 TCGTATAATGTGTGGATTTTGTAGTTAGGATCCGGCGAGATTTTCAGGAGCTAAGGAAGCT
 AAAATGGAGAAAAAATCACTGGATATACCACCGTTGATATATCCCAATGGCATCGTAAA
 GAACATTTTGAGGCATTTTCAGTCAGTTGCTCAATGTACCTATAACCAGACCGTTTCAGCTG
 GATATTACGGCCTTTTAAAGACCGTAAAGAAAAATAAGCACAAGTTTTATCCGGCCTTT
 ATTCACATTCCTTGCCCGCCTGATGAATGCTCATCCGGAATTCCGTATGGCAATGAAAGAC
 GGTGAGCTGGTGATATGGGATAGTGTTCAACCCTTGTTACACCGTTTCCATGAGCAAAC
 GAAACGTTTTTCATCGCTCTGGAGTGAATACCACGACGATTTCCGGCAGTTTCTACACATA
 TATTGCAAGATGTGGCGTGTTACGGTGAAAACCTGGCCTATTTCCTAAAGGGTTTTATT
 GAGAATATGTTTTTCGTCTCAGCCAATCCCTGGGTGAGTTTCAACAGTTTTGATTTAAAC
 GTGGCCAATATGGACAACCTTCTCGCCCCCGTTTTCAACATGGGCAAATATTATACGCAA
 GCGGACAAGGTGCTGATGCCGCTGGCGATTACGGTTCATCATGCCGTCTGTGATGGCTTC
 CATGTCGGGCAGAATGCTTAATGAATTACAACAGTACTGCGATGAGTGGCAGGGCGGGGCG
 TAAACGCGTGGATCCGGCTTACTAAAAGCCAGATAACAGTATGCGTATTTGCGCGCTGAT
 TTTTGCGGTATAAGAATATATACTGATATGTATACCCGAAGTATGTCAAAAAGAGGTGTG
 CTATGAAGCAGCGTATTACAGTGACAGTTGACAGCGACAGCTATCAGTTGCTCAAGGCAT
 ATATGATGTCAATATCTCCGGTCTGGTAAGCACAACCATGCAGAATGAAGCCCGTCTGCT
 GCGTGCCGAACGCTGGAAAGCGGAAAATCAGGAAGGGATGGCTGAGGTGCCCCGGTTTTAT
 TGAAATGAACGGCTCTTTTGCTGACGAGAACAGGGACTGGTGAAATGCAGTTTAAGGTTT
 ACACCTATAAAAGAGAGAGCCGTTATCGTCTGTTTGTGGATGTACAGAGTGATATTATG
 ACACGCCCCGGGCGACGGATGGTGATCCCCCTGGCCAGTGACAGTCTGCTGTGATATAAG
 TCTCCCGTGAACCTTTACCCGGTGGTGATATCGGGGATGAAAGCTGGCGCATGATGACCA
 CCGATATGGCCAGTGTGCCGGTCTCCGTTATCGGGGAAGAAGTGGCTGATCTCAGCCACC
 GCGAAAATGACATCAAAAACGCCATTAACCTGATGTTCTGGGGAATATAAATGTGAGGCT
 CCCTTATACACAGCCAGTCTGCAGGTGACCATAGTGACTGGATATGTTGTGTTTTACAG
 TATTATGTAGTCTGTTTTTTATGCAAAATCTAATTTAATATATTGATATTTATATCATT
 TACGTTTTCTCGTTTCAGCTTTCTTGTAAGAGTGGTGATTATGTCCCTATACTAGGTTAT
 TGGAAAATTAAGGGCCTTGTGCAACCCACTCGACTTCTTTTGAATATCTTGAAGAAAAA
 TATGAAGAGCATTGTGATGAGCGCGATGAAGGTGATAAATGGCGAAACAAAAGTTTGAA
 TTGGGTTTGGAGTTTCCCAATCTTCCTTATTATATTGATGGTGATGTTAAATTAACACAG
 TCTATGGCCATCATACGTTATATAGCTGACAAGCACACATGTTGGGTGGTTGTCCAAAA
 GAGCGTGACAGAGATTTCAATGCTTGAAGGAGCGGTTTTGGATATTAGATACGGTGTTTCG
 AGAATTGCATATAGTAAAGACTTTGAAACTCTCAAAGTTGATTTTTCTTAGCAAGCTACCT
 GAAATGCTGAAAATGTTTCGAAGATCGTTTTATGTCATAAAACATATTAAATGGTGATCAT
 GTAACCCATCCTGACTTCATGTTGTATGACGCTCTTGATGTTGTTTTATACATGGACCCA
 ATGTGCTTGGATGCGTTCCCAAAATTAGTTTGTGTTTTAAAAACGTATTGAAGCTATCCCA
 CAAATTGATAAGTATGAAATCCAGCAAGTATATAGCATGGCCTTTGCAGGGCTGGCAA
 GCCACGTTTGGTGGTGGCGACCATCCTCCAAAATCGGATCTGGTTCCGCGTCCATGGGGA
 TCCGGCTGCTAACAAAGCCGAAAGGAAGCTGAGTTGGCTGCTGCCACCGCTGAGCGCTT
 CCCGATAAGGGAGCAGGCCAGTAAAGCATTACCCGTGGTGGGTTCCCGAGCGGCCAAA
 GGGAGCAGACTCTAAATCTGCCGTCTCGACTTCGAAGGTTTGAATCCTTCCCCCACCAC
 CATCACTTTCAAAAGTGAATTCGCTGAGCAATAACTAGCATAAACCCTTGGGGCCTCTAA-

FIGURE 96B

ACGGGTCTTGAGGGGTTTTTGTCTGAAAGGAGGAACTATATCCGGATATCCACAGGACGG
GTGTGGTCGCCATGATCGCGTAGTCGATAGTGGCTCCAAGTAGCGAAGCGAGCAGGACTG
GGCGGCGGCCAAAGCGGTCCGACAGTGTCTCCGAGAACGGGTGCGCATAGAAATTGCATCA
ACGCATATAGCGCTAGCAGCACGCCATAGTGAAGTGGCGATGCTGTCGGAATGGACGATAT
CCCGCAAGAGGCCCCGGCAGTACCGGCATAACCAAGCCTATGCCTACAGCATCCAGGGTGA
CGGTGCCGAGGATGACGATGAGCGCATTGTTAGATTTATACACCGGTGCCTGACTGCGTT
AGCAATTTAACTGTGATAAACTACCGCATTAAAGCTTATCGATGATAAGCTGTCAAACAT
GAGAATTCTTGAAGACGAAAGGGCCTCGTGATACGCCTATTTTTTATAGGTAAATGTCATG
ATAATAATGGTTTCTTAGACGTGAGTGGCACTTTTCGGGGAAATGTGCGCGGAACCCCT
ATTTGTTTATTTTTCTAAATACATTCAAATATGTATCCGCTCATGAGACAATAACCCCTGA
TAAATGCTTCAATAATATTGAAAAAGGAAGAGTATGAGTATTCAACATTTCCGTGTCGCC
CTTATTCCTTTTTTTCGCGGCATTTTGCCTTCCTGTTTTTGTCTCACCAGAAACGCTGGTG
AAAGTAAAAGATGCTGAAGATCAGTTGGGTGCACGAGTGGGTACATCGAACTGGATCTC
AACAGCGGTAAGATCCTTGAGAGTTTTTCGCCCCGAAGAACGTTTTCCAATGATGAGCACT
TTTAAAGTTCTGCTATGTGGCGCGGTATTATCCCGTGTGACGCCGGGCAAGAGCAACTC
GGTCGCCGCATACACTATTCTCAGAATGACTTGGTTGAGTACTCACCAGTCACAGAAAAG
CATCTTACGGATGGCATGACAGTAAGAGAATTATGCAGTGCTGCCATAACCATGAGTGAT
AACACTGCGGCCAACTTACTTCTGACAACGATCGGAGGACCGAAGGAGCTAACCGCTTTT
TTGCACAACATGGGGGATCATGTAACCTCGCCTTGATCGTTGGGAACCGGAGCTGAATGAA
GCCATACCAAACGACGAGCGTGACACCACGATGCCTGCAGCAATGGCAACAACGTTGCGC
AACTATTAACTGGCGAACTACTTACTCTAGCTTCCCGGCAACAATTAATAGACTGGATG
GAGGCGGATAAAGTTGCAGGACCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTTATT
GCTGATAAATCTGGAGCCGGTGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCA
GATGGTAAGCCCTCCCGTATCGTAGTTATCTACACGACGGGGAGTCAGGCAACTATGGAT
GAACGAAATAGACAGATCGCTGAGATAGGTGCCTCACTGATTAAAGCATTGGTAAGTCA
GACCAAGTTTACTCATATATACTTTTAGATTGATTTAAACTTCATTTTTAATTTAAAGG
ATCTAGGTGAAGATCCTTTTTGATAATCTCATGACCAAAATCCCTTAACGTGAGTTTTCG
TTCCACTGAGCGTCAGACCCCGTAGAAAAGATCAAAGGATCTTCTTGAGATCCTTTTTTT
CTGCGCGTAATCTGCTGCTTGCAACAAAAAACCACCGCTACCAGCGGTGGTTTTGTTTG
CCGGATCAAGAGCTACCAACTCTTTTTCCGAAGGTAAGTGGCTTCAGCAGAGCGCAGATA
CCAAATACTGTCCTTCTAGTGTAGCCGTAGTTAGGCCACCACTTCAAGAACTCTGTAGCA
CCGCCTACATACCTCGCTCTGCTAATCCTGTTACCAGTGGCTGCTGCCAGTGGCGATAAG
TCGTGTCTTACCGGGTTGGACTCAAGACGATAGTTACCGGATAAGGCGCAGCGGTGGGC
TGAACGGGGGGTTCTGTGCACACAGCCAGCTTGGAGCGAAGACCTACACCGAACTGAGA
TACCTACAGCGTGAGCTATGAGAAAGCGCCACGCTTCCCGAAGGGAGAAAGGCGGACAGG
TATCCGGTAAGCGGCAGGGTCCGAACAGGAGAGCGCACGAGGGAGCTTCCAGGGGGAAC
GCCTGGTATCTTTATAGTCTGTGCGGTTTCGCCACCTCTGACTTGAGCGTCGATTTTTG
TGATGCTCGTCAGGGGGGCGGAGCCTATGGAACAAACGCCAGCAACGCGGCCTTTTTACGG
TTCCTGGCCTTTTTGCTGGCCTTTTTGCTCACATGTTCTTTCCTGCGTTATCCCCTGATTCT
GTGGATAACCGTATTACCGCCTTTGAGTGAGCTGATACCGCTCGCCGCAGCCGAACGACC
GAGCGCAGCGAGTCAGTGAGCGAGGAAGCGGAAGAGCGCCTGATGCGGTATTTTCTCCTT
ACGCATCTGTGCGGTATTTACACCCGCATATATGGTGCCTCTCAGTACAATCTGCTCTG
ATGCCGCATAGTTAAGCCAGTATACACTCCGCTATCGCTACGTGACTGGGTCAATGGCTGC
GCCCGGACACCCGCAACACCCGCTGACGCGCCCTGACGGGCTTGTCTGCTCCCGGCATC
CGCTTACAGACAAGCTGTGACCGTCTCCGGGAGCTGCATGTGTGAGAGGTTTTACCGTCT
ATCACCGAAACGCGCGAGGCAGCTGCGGTAAAGCTCATCAGCGTGGTCGTGAAGCGATTCT
ACAGATGTCTGCCTGTTTATCCGCGTCCAGCTCGTTGAGTTTCTCCAGAAGCGTTAATGT
CTGGCTTCTGATAAAGCGGGCCATGTTAAGGGCGGTTTTTTCTGTTTGGTCACTGATGC
CTCCGTGTAAGGGGGATTTCTGTTTATGGGGGTAATGATACCGATGAAACGAGAGAGGAT
GCTCACGATACGGGTACTGATGATGAACATGCCCGGTTACTGGAACGTTGTGAGGGTAA
ACAACTGGCGGTATGGATGCGGCGGGACAGAGAAAAATCACTCAGGGTCAATGCCAGCG
CTTCGTTAATAACAGATGTAGGTGTTCCACAGGGTAGCCAGCAGCATCCTGCGATGCAGAT
CCGGAACATAATGGTGCAGGGCGCTGACTTCCGCGTTTCCAGACTTACGAAACACGGAA
ACCGAAGACCATTCATGTTGTTGCTCAGGTGCGAGACGTTTTTGACGAGCAGTCGCTTCA
CGTTGCTCGCTGCGTATCGGTGATTCTTCTGCTAACAGTAAGGCAACCCCGCCAGCCTAG
CCGGTCTCTCAACGACAGGAGCAGCATCATGCGCACCCGTGGCCAGGACCCAACGCTGCC
CGAGATGCGCCGCGTGCGGCTGCTGGAGATGGCGGACGCGATGGATATGTTCTGCCAAGG
GTTGGTTTTGCGCATTCACAGTTCTCCGCAAGAATTGATTGGCTCCAATTCTTGAGTGGT-

FIGURE 96C

GAATCCGTTAGCGAGGTGCCGCCGGCTTCCATTTCAGGTCGAGGTGGCCCCGGCTCCATGCA
CCGCGACGCAACGCGGGGAGGCAGACAAGGTATAGGGCGGCGCCTACAATCCATGCCAAC
CCGTTCCATGTGCTCGCCGAGGCGGCATAAATCGCCGTGACGATCAGCGGTCCAGTGATC
GAAGTTAGGCTGGTAAGAGCCGCGAGCGATCCTTGAAGCTGTCCCTGATGGTCGTCATCT
ACCTGCCTGGACAGCATGGCCTGCAACGCGGGCATCCCGATGCCGCCGGAAGCGAGAAGA
ATCATAATGGGGAAGGCCATCCAGCCTCGCGTCGCGAACGCCAGCAAGACGTAGCCCAGC
GCGTCGGCCGCCATGCCGGCGATAATGGCCTGCTTCTCGCCGAAACGTTTGGTGGCGGGA
CCAGTGACGAAGGCTTGAGCGAGGGCGTGCAAGATTCCGAATACCGCAAGCGACAGGCCG
ATCATCGTCGCGCTCCAGCGAAAGCGGTCCTCGCCGAAAATGACCCAGAGCGCTGCCGGC
ACCTGTCTTACGAGTTGCATGATAAAGAAGACAGTCATAAGTGCGGCGACGATAGTCATG
CCCCGCGCCACCGGAAGGAGCTGACTGGGTTGAAGGCTCTCAAGGGCATCGGTTCGATCG
ACGCTCTCCCTTATGCGACTCCTGCATTAGGAAGCAGCCCAGTAGTAGGTTGAGGCCGTT
GAGCACCGCCGCGCAAGGAATGGTGCATGCAAGGAGATGGCGCCCAACAGTCCCCCGGC
CACGGGGCCTGCCACCATACCCACGCCGAAACAAGCGCTCATGAGCCCGAAGTGGCGAGC
CCGATCTTCCCCATCGGTGATGTCGGCGATATAGGCGCCAGCAACCGCACCTGTGGCGCC
GGTGATGCCGGCCACGATGCGTCCGGCGTAGAGG

FIGURE 96d

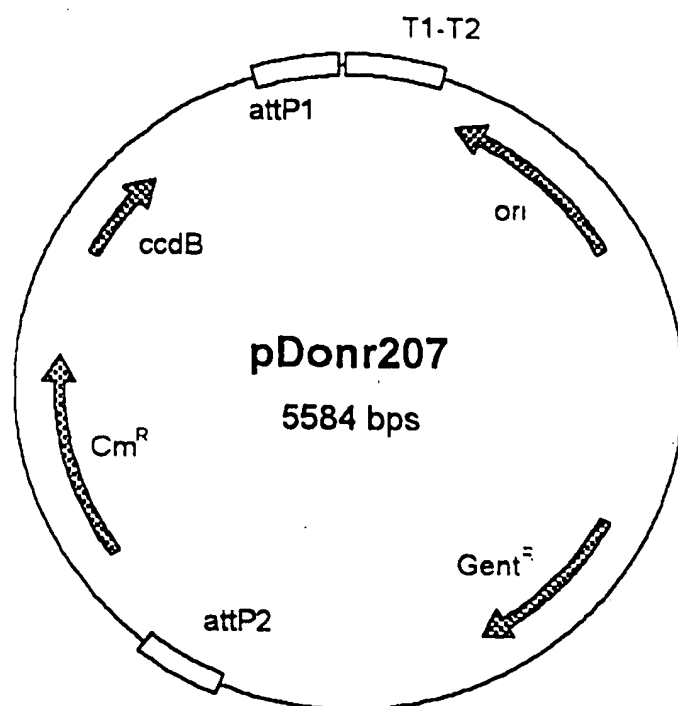


FIGURE 97A

pDONR207

5584 bp

GCGAGAGTAGGGAACTGCCAGGCATCAAATAAAACGAAAGGCTCAGTCGGAAGACTGGGC
CTTTTCGTTTTATCTGTTTGTGTCGGTGAACGCTCTCCTGAGTAGGACAAATCCGCCGGG
AGCGGATTTGAACGTTGTGAAGCAACGGCCCGAGGGTGGCGGGCAGGACGCCCGCCATA
AACTGCCAGGCATCAAACCTAAGCAGAAGGCCATCCTGACGGATGGCCTTTTTGCGTTTCT
ACAAACTCTTCTGGCTAGCGGTAATACGGTTATCCACAGAATCAGGGGATAACGCAGGA
AAGAACATGTGAGCAAAAGGCCAGCAAAAGGCCAGGAACCGTAAAAAGGCCGCGTTGCTG
GCGTTTTTCCATAGGCTCCGCCCCCTGACGAGCATCACAAAATCGACGCTCAAGTCAG
AGGTGGCGAAACCCGACAGGACTATAAAGATAACAGGCGTTTTCCCCCTGGAAGCTCCCTC
GTGCGCTCTCCTGTTCCGACCCTGCCGCTTACCGGATACCTGTCCGCTTTCTCCCTTCG
GGAAGCGTGGCGCTTTCTCATAGCTCACGCTGTAGGTATCTCAGTTCGGTGTAGGTCGTT
CGCTCCAAGCTGGGCTGTGTGCACGAACCCCCGTTTCAGCCCGACCGCTGCGCCTTATCC
GGTAATATCGTCTTGAGTCCAACCCGGTAAGACACGACTTATCGCCACTGGCAGCAGCC
ACTGGTAACAGGATTAGCAGAGCGAGGTATGTAGCGGTGCTACAGAGTTCTTGAAGTGG
TGGCCTAACTACGGCTACACTAGAAGGACAGTATTTGGTATCTGCGCTCTGCTGAAGCCA
GTTACCTTCGGA AAAAGAGTTGGTAGCTCTTGATCCGGCAAACAAACACCGCTGGTAGC
GGTGGTTTTTTTTGTTTGAAGCAGCAGATTACGCGCAGAAAAAAGGATCTCAAGAAGAT
CCTTTGATCTTTTCTACGGGGTCTGACGCTCAGTGGAAACGAAACTCACGTTAAGGGATT
TTGGTCATGAGCTTGCGCCGTCCCGTCAAGTCAGCGTAATGCTCTGCCAGTGTTACAACC
AATTAACCAATTCTGATTAGAAAACTCATCGAGCATCAAATGAACTGCAATTTATTCA
TATCAGGATTATCAATACCATATTTTTGAAAAAGCCGTTTCTGTAATGAAGGAGAAAACT
CACCGAGGCAGTTCATAGGATGGCAAGATCCTGGTATCGGTCTGCGATTCCGACTCGTC
CAACATCAATACAACTATTAGTAGCCAAACCACTAGAACTATAGCTAGAGTCCTGGGCGA
ACAAACGATGCTCGCCTTCCAGAAAACCGAGGATGCGAACCCTTCATCCGGGGTCAAGCA
CCACCGGCAAGCGCCGCGACGGCCGAGGTCTTCCGATCTCCTGAAGCCAGGGCAGATCCG
TGCACAGCACCTTGCCGTAGAAGAACAGCAAGGCCGCCAATGCCTGACGATGCGTGGAGA
CCGAAACCTTGCGCTCGTTCGCCAGCCAGGACAGAAATGCCTCGACTTCGCTGCTGCCCA
AGGTTGCCGGGTGACGCACACCGTGGAACGGATGAAGGCACGAACCCAGTTGACATAAG
CCTGTTCCGGTTCGTAAACTGTAATGCAAGTAGCGTATGCGCTCACGCAACTGGTCCAGAA
CCTTGACCGAACGCAGCGGTGGTAACGGCGCAGTGGCGGTTTTTCATGGCTTGTTATGACT
GTTTTTTTGTACAGTCTATGCCTCGGGCATCCAAGCAGCAAGCGCGTTACGCCGTGGGT
GATGTTTTGTATGTTATGGAGCAGCAACGATGTTACGCAGCAGCAACGATGTTACGCAGCAG
GGCAGTCGCCCTAAACAAAGTTAGGTGGCTCAAGTATGGGCATCATTTCGCACATGTAGG
CTCGGCCCTGACCAAGTCAAATCCATGCGGGCTGCTCTTGATCTTTTCGGTCGTGAGTTC
GGAGACGTAGCCACCTACTCCCAACATCAGCCGACTCCGATTACCTCGGGAACCTTGCTC
CGTAGTAAGACATTTCATCGCGCTTGCTGCCTTCGACCAAGAAGCGGTTGTTGGCGCTCTC
GCGGCTTACGTTCTGCCCAGGTTTGAGCAGCCGCGTAGTGAGATCTATATCTATGATCTC
GCAGTCTCCGGCGAGCACCGGAGGCAGGGCATTGCCACCGCGCTCATCAATCTCCTCAAG
CATGAGGCCAACGCGCTTGTTGCTTATGTGATCTACGTGCAAGCAGATTACGGTGACGAT
CCCGCAGTGGCTCTCTATACAAAGTTGGGCATACGGGAAGAAGTGATGCACTTTGATATC
GACCCAAGTACCGCCACCTAACAAATCGTTCAAGCCGAGATCGGCTTCCCGGCCTAATTT
CCCCTCGTCAAAAATAAGGTTATCAAGTGAGAAATCACCATGAGTGACGACTGAATCCGG
TGAGAATGGCAAAAGTTTATGCATTTCTTTCCAGACTTGTTCAACAGGCCAGCCATTACG
CTCGTCATCAAATCACTCGCATCAACCAACCGTTATTCATTGCTGATTGCGCCTGAGC
GAGACGAAATACGCGATCGCTGTTAAAAGGACAATTACAAACAGGAATCGAATGCAACCG
GCGCAGGAACACTGCCAGCGCATCAACAATATTTTACCTGAATCAGGATATTCTTCTAA
TACCTGGAATGCTGTTTTTCCGGGGATCGCAGTGGTGAGTAACCATGCATCATCAGGAGT
ACGGATAAAATGCTTGATGGTCCGAAGAGGCATAAAATCCGTCAGCCAGTTTAGTCTGAC
CATCTCATCTGTAACATCATTGGCAACGCTACCTTTGCCATGTTTCAGAAACAACTCTGG
CGCATCGGCTTCCCATACAAGCGATAGATTGTGCGACCTGATTGCCCGACATTATCGCG
AGCCCATTTATACCCATATAAATCAGCATCCATGTTGGAATTTAATCGCGGCCCTCGACGT
TTCCCGTTGAATATGGCTCATAACACCCCTGTATTACTGTTTATGTAAGCAGACAGTTT
TATTGTTTCATGATGATATATTTTTATCTGTGCAATGTAACATCAGAGATTTTGAGACAC
GGGCCAGAGCTGCAGCTGGATGGCAAATAATGATTTTATTTTACTGATAGTGACCTGTT
CGTTGCAACAAATTGATAAGCAATGCTTTCTTATAATGCCAACTTTGTACAAGAAAGCTG
AACGAGAAACGTAATGATATAAATATCAATATATTAAATTAGATTTTGCATAAAAAAC
AGACTACATAATACTGTAAACACAACATATCCAGTCACTATGAATCAACTACTTAGATG-

FIGURE 97B

GTATTAGTGACCTGTAGTCGACTAAGTTGGCAGCATCACCCGACGCACTTTGCGCCGAAT
AAATACCTGTGACGGAAGATCACTTCGCAGAATAAATAAATCCTGGTGTCCCTGTTGATA
CCGGGAAGCCCTGGGCCAACTTTGGCGAAAATGAGACGTTGATCGGCACGTAAGAGGTTTC
CAACTTTTACCATAAATGAAATAAGATCACTACCGGGCGTATTTTTTTGAGTTATCGAGATT
TTCAGGAGCTAAGGAAGCTAAAATGGAGAAAAAATCACTGGATATACCACCGTTGATAT
ATCCCAATGGCATCGTAAAGAACATTTTGAGGCATTTTCAGTCAGTTGCTCAATGTACCTA
TAACCAGACCGTTTCAGCTGGATATTACGGCCTTTTTTAAAGACCGTAAAGAAAAATAAGCA
CAAGTTTTATCCGGCCTTTATTACATTCTTGCCCGCCTGATGAATGCTCATCCGGAATT
CCGTATGGCAATGAAAGACGGTGAGCTGGTGATATGGGATAGTGTTCAACCCTTGTTACAC
CGTTTTCCATGAGCAAACCTGAAACGTTTTTCATCGCTCTGGAGTGAATACCACGACGATTT
CCGGCAGTTTCTACACATATATTTCGAAGATGTGGCGTGTTACGGTGAAAACCTGGCCTA
TTTCCCTAAAGGGTTTATTGAGAATATGTTTTTCGTCTCAGCCAATCCCTGGGTGAGTTT
CACCAGTTTTGATTTAAACGTGGCCAATATGGACAACCTTCTCGCCCCCGTTTTTCACCAT
GGGCAATATTATACGCAAGGCGACAAGGTGCTGATGCCGCTGGCGATTTCAGGTTTCATCA
TGCCGTCTGTGATGGCTTCCATGTCCGCAGAATGCTTAATGAATTACAACAGTACTGCGA
TGAGTGGCAGGGCGGGGCGTAATCCGCTGGATCCGGCTTACTAAAAGCCAGATAACAGTA
TGCCTATTTGCGCGCTGATTTTTTGGCGTATAAGAATATATACTGATATGTATACCCGAAG
TATGTCAAAAAGAGGTGTGCTATGAAGCAGCGTATTACAGTGACAGTTGACAGCGACAGC
TATCAGTTGCTCAAGGCATATATGATGTCAATATCTCCGGTCTGGTAAGCACAACCATGC
AGAATGAAGCCCGTCGTCTGCGTGCCGAACGCTGGAAAGCGGAAAATCAGGAAGGGATGG
CTGAGGTCCGCCGTTTATTGAAATGAACGGCTCTTTTGCTGACGAGAACAGGGACTGGT
GAAATGCAGTTTAAGGTTTACACCTATAAAAGAGAGAGCCGTTATCGTCTGTTTGTGGAT
GTACAGAGTGATATTATTGACACGCCCCGGGCGACGGATGGTGATCCCCCTGGCCAGTGCA
CGTCTGCTGTGATATAAAGTCTCCCGTGAACTTTACCCGGTGGTGATATCGGGGATGAA
AGCTGGCGCATGATGACCACCGATATGGCCAGTGTGCCGGTCTCCGTTATCGGGGAAGAA
GTGGCTGATCTCAGCCACCGCGAAAATGACATCAAAAACGCCATTAACTGATGTTCTGG
GGAATATAAATGTCAGGCTCCCTTATACACAGCCAGTCTGCAGGTGATACAGTAGAAAT
TACAGAACTTTATCACGTTTAGTAAGTATAGAGGCTGAAAATCCAGATGAAGCCGAACG
ACTTGTAAGAGAAAAGTATAAGAGTTGTGAAATTGTTCTTGATGCAGATGATTTTCAGGA
CTATGACACTAGCGTATATGAATAGGTAGATGTTTTTATTTTGTACACAAAAAAGAGGC
TCGCACCTCTTTTTCTTATTTCTTTTTATGATTTAATACGGCATTGAGGACAATAGCGAG
TAGGCTGGATACGACGATTCCGTTTGAGAAGAACATTTGGAAGGCTGTCCGGTCGACTAAG
TTGGCAGCATCACCCGAAGAACATTTGGAAGGCTGTCCGGTCGACTACAGGTCACTAATAC
CATCTAAGTAGTTGATTCATAGTGACTGGATATGTTGTGTTTTACAGTATTATGTAGTCT
GTTTTTTATGCAAAATCTAATTTAATATATTGATATTTATATCATTTTACGTTTCTCGTT
CAGCTTTTTTGTACAAAGTTGGCATTATAAAAAAGCATTGCTCATCAATTTGTTGCAACG
AACAGGTCACTATCAGTCAAAATAAATCATTATTTGGGGCCCCGAGATCCATGCTAGCGT
TAAC

FIGURE 97C

pMAB85

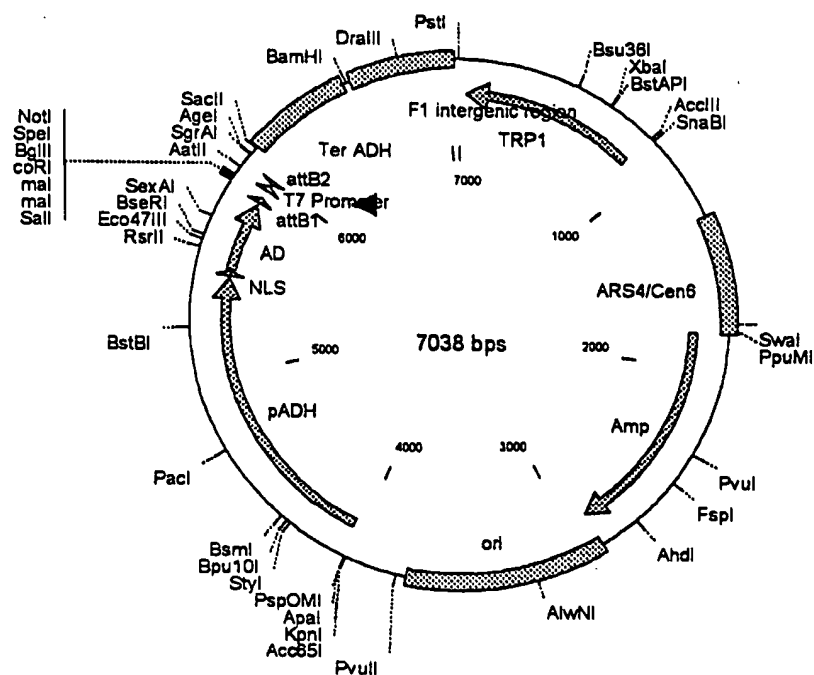


FIGURE 98A

pMAB85 7038 bp

GCCTTACGCATCTGTGCGGTATTTACACCCGAGGCAAGTGCACAAACAATACTTAAATA
AATACTACTCAGTAATAACCTATTTCTTAGCATTTTTGACGAAATTTGCTATTTTGTTAG
AGTCTTTTACACCATTTGTCTCCACACCTCCGCTTACATCAACACCAATAACGCCATTTA
ATCTAAGCGCATCACCAACATTTTCTGGCGTCAGTCCACCAGCTAACATAAAATGTAAGC
TTTCGGGGCTCTCTTGCCCTCCAACCCAGTCAGAAATCGAGTTCCAATCCAAAAGTTTAC
CTGTCCCACCTGCTTCTGAATCAAACAAGGGAATAAACGAATGAGGTTTCTGTGAAGCTG
CACTGAGTAGTATGTTGCAGTCTTTTGGAAATACGAGTCTTTAATAACTGGCAAACCGA
GGAACCTCTTGGTATTCTTGCCACGACTCATCTCCATGCAGTTGGACGATATCAATGCCGT
AATCATTGACCAGAGCCAAAACATCCTCCTTAGGTTGATTACGAAACACGCCAACCAAGT
ATTTCCGGAGTGCCCTGAACATATTTTATATGCTTTTACAAGACTTGAAATTTTCCTTGCAA
TAACCGGGTCAATTGTTCTCTTTCTATTGGGCACACATATAATACCCAGCAAGTCAGCAT
CGGAATCTAGAGCACATTCTGCGGCCTCTGTGCTCTGCAAGCCGCAAACTTTCACCAATG
GACCAGAACTACCTGTGAAATTAATAACAGACATACTCCAAGCTGCCTTTGTGTGCTTAA
TCACGTATACTCACGTGCTCAATAGTCACCAATGCCCTCCCTCTTGCCCTCTCCTTTTC
TTTTTTTCGACCGAATTAATTCTTAATCGGCAAAAAAGAAAGCTCCGGATCAAGATTGT
ACGTAAGGTGACAAGCTATTTTTCAATAAAGAATATCTTCCACTACTGCCATCTGGCGTC
ATAACTGCAAAGTACACATATATTACGATGCTGTCTATTAAATGCTTCCTATATTATATA
TATAGTAATGTCGTTTATGGTGCACTCTCAGTACAATCTGCTCTGATGCCGCATAGTTAA
GCCAGCCCCGACACCCGCCAACCCCGCTGACGCGCCCTGACGGGCTTGTCTGCTCCCGG
CATCCGCTTACAGACAAGCTGTGACCGTCTCCGGGAGCTGCATGTGTCTAGAGGTTTTCAC
CGTCATCACCGAAACGCGCGAGACGAAAGGGCCTCGTGATACGCCTATTTTTATAGGTTA
ATGTCATGATAATAATGGTTTCTTAGGACGGATCGCTTGCCTGTAACCTTACACGCGCCTC
GTATCTTTTAATGATGGAATAATTTGGGAATTTACTCTGTGTTTATTTATTTTATGTTT
TGTATTTGGATTTTAGAAAGTAAATAAAGAAGGTAGAAGAGTTACGGAATGAAGAAAAA
AAATAAACAAAGGTTTAAAAAATTTCAACAAAAGCGTACTTTACATATATATTTATTAG
ACAAGAAAAGCAGATTAAATAGATATACATTCGATTAAAGATAAGTAAATGTAAATCA
CAGGATTTTCGTGTGTGGTCTTCTACACAGACAAGATGAAACAATTCGGCATTAATACCT
GAGAGCAGGAAGAGCAAGATAAAAGGTAGTATTTGTTGGCGATCCCCCTAGAGTCTTTTA
CTATTTTCGGAACCAAAACTATTTTTCTTTAATTTCTTTTTTTACTTTCTATTTTTTAA
TTTATATATTTATATTAAAAAATTTAAATTATAATTATTTTTATAGCACGTGATGAAAAG
GACCCAGGTGGCACTTTTCGGGGAAATGTGCGCGGAACCCCTATTTGTTTATTTTTCTAA
ATACATTCAAATATGTATCCGCTCATGAGACAATAACCCTGATAAATGCTTCAATAATAT
TGAAAAGGAAGAGTATGAGTATTCAACATTTCCGTGTGCGCCTTATTCCCTTTTTTGCG
GCATTTTGCCCTTCTGTTTTTGTCTACCCAGAAACGCTGGTGAAAGTAAAGATGCTGAA
GATCAGTTGGGTGCACGAGTGGGTTACATCGAACTGGATCTCAACAGCGGTAAGATCCTT
GAGAGTTTTCGCCCCGAAGAAGCTTTTCCAATGATGAGCACTTTTAAAGTTCTGCTATGT
GGCGCGGTATTATCCCGTATTGACGCCGGGCAAGAGCAACTCGGTGCGCCGATACACTAT
TCTCAGAATGACTTGGTTGAGTACTCACCAGTCACAGAAAAGCATCTTACGGATGGCATG
ACAGTAAGAGAATTATGCACTGCTGCCATAACCATGAGTGATAAACAAGTGGGCCAACTTA
CTTCTGACAACGATCGGAGGACCGAAGGAGCTAACCGCTTTTTTTTCAACATGGGGGAT
CATGTAACCTCGCCTTGATCGTTGGGAACCGGAGCTGAATGAAGCCATACCAAACGACGAG
CGTGACACCACGATGCCTGTAGCAATGGCAACAACGTTGCGCAAACCTATTAAGTGGCGAA
CTACTTACTCTAGCTTCCCGGCAACAATTAATAGACTGGATGGAGGCGGATAAAGTTGCA
GGACCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTATTGCTGATAAATCTGGAGCC
GGTGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCAGATGGTAAGCCCTCCCGT
ATCGTAGTTATCTACACGACGGGCAGTCAGGCAACTATGGATGAACGAAATAGACAGATC
GCTGAGATAGGTGCCCTCACTGATTAAAGCATTTGTAACCTGTGACACCAAGTTTACTCATAT
ATACTTTAGATTGATTTAAAACTTCATTTTAAATTTAAAGGATCTAGGTGAAGATCCTT
TTTGATAATCTCATGACCAAAATCCCTTAACGTGAGTTTTCTGTTCCACTGAGCGTCAGAC
CCCGTAGAAAAGATCAAAGGATCTTCTTGAGATCCTTTTTTTCTGCGCGTAATCTGCTGC
TTGCAACAAAAAAACCACCGCTACCAGCGGTGGTTTGTGTTGCGGATCAAGAGCTACCA
ACTCTTTTTCCGAAGGTAAGTGGCTTACGAGAGCGCAGATACCAAATACTGTCCTTCTA
GTGTAGCCGTAGTTAGGCCACCACTTCAAGAACTCTGTAGCACCGCTACATACCTCGCT
CTGCTAATCCTGTTACCAAGTGGCTGCTGCCAGTGGCGATAAGTCGTGTCTTACCGGGTTG
GACTCAAGACGATAGTTACCGGATAAGGCGCAGCGGTGCGGCTGAACGGGGGGTTCTGTGC-

FIGURE 98B

ACACAGCCCAGCTTGGAGCGAACGACCTACACCGAACTGAGATACCTACAGCGTGAGCAT
TGAGAAAGCGCCACGCTTCCCGAAGGGAGAAAGGCGGACAGGTATCCGGTAAGCGGCAGG
GTCGGAACAGGAGAGCGCACGAGGGAGCTTCCAGGGGGGAACGCCTGGTATCTTTATAGT
CCTGTGCGGTTTTCGCCACCTCTGACTTGAGCGTCGATTTTTGTGATGCTCGTCAGGGGGG
CCGAGCCTATGGAACCGCCAGCAACGCGGCCTTTTTACGGTTCCTGGCCTTTTGCTGG
CCTTTTGCTCACATGTTCTTCTGCGTTATCCCCTGATTCTGTGGATAACCGTATTACC
GCCTTTGAGTGAGCTGATACCGCTCGCCGACCGCAACGACCGAGCGCAGCGAGTCAGTG
AGCGAGGAAGCGGAAGAGCGCCCAATACGCAAAACCGCCTCTCCCCGCGCGTTGGCCGATT
CATTAATGCAGCTGGCAGCAGAGTTTCCCGACTGGAAAGCGGGCAGTGAGCGCAACGCA
ATTAATGTGAGTTACCTCACTCATTAGGCACCCCAGGCTTTACACTTTATGCTTCCGGCT
CCTATGTTGTGTGGAATTGTGAGCGGATAACAATTTACACAGGAAACAGCTATGACCAT
GATTACGCCAAGCTCGGAATTAACCCTCACTAAAGGGAACAAAAGCTGGGTACCGGGCCC
CCCCTCGAGATCCGGGATCGAAGAAATGATGGTAAATGAAATAGGAAATCAAGGAGCATG
AAGGCAAAAGACAAATATAAGGGTCGAACGAAAAATAAAGTGAAAAGTGTTGATATGATG
TATTTGGCTTTGCGGCGCCGAAAAACGAGTTTACGCAATTGCACAATCATGCTGACTCT
GTGGCGGACCCGCGCTCTTGCCGCGCCGCGGATAACGCTGGGCGTGAGGCTGTGCCCGG
GGAGTTTTTTGCGCCTGCATTTTCCAAGGTTTACCCTGCGCTAAGGGGCGAGATTGGAGA
AGCAATAAGAATGCCGTTTGGGTTGCGATGATGACGACCAGCAACTGGTGTCTATTAT
TTAAGTTGCCGAAAGAACCTGAGTGCATTTGCAACATGAGTATACTAGAAGAATGAGCCA
AGACTTGCGAGACGCGAGTTTGCCGGTGGTGCGAACAATAGAGCGACCATGACCTTGAAG
GTGAGACGCGCATAACCGCTAGAGTACTTTGAAGAGGAAACAGCAATAGGGTTGCTACCA
GTATAAATAGACAGGTACATACAACACTGGAAATGGTTGTCTGTTTGAGTACGCTTTCAA
TTCATTTGGGTGTGCACTTTATTATGTTACAATATGGAAGGGAACCTTTACACTTCTCCTA
TGCACATATATTAATTAAAGTCCAATGCTAGTAGAGAAGGGGGTAACACCCCTCCGCGC
TCTTTTCCGATTTTTTTCTAAACCGTGGAATATTTTCGGATATCCTTTTGTGTTTCCGGG
TGTACAATATGGACTTCTCTCTTTCTGGCAACCAACCCATACATCGGGATTCTCTAAT
ACCTTCGTTGGTCTCCCTAACATGTAGGTGGCGGAGGGGAGATATACAATAGAACAGATA
CCAGACAAGACATAATGGGCTAAACAAGACTACACCAATTACACTGCCTCATTGATGGTG
GTACATAACGAACTAATACTGTAGCCCTAGACTTGATAGCCATCATCATATCGAAGTTTC
ACTACCCTTTTTCCATTTGCCATCTATTGAAGTAATAATAGGCGCATGCAACTTCTTTTC
TTTTTTTTTCTTTTCTCTCTCCCCGTTGTTGTCTCACCATATCCGCAATGACAAAAAA
ATGATGGAAGACACTAAAGGAAAAAATTAACGACAAAGACAGCACCAACAGATGTCGTTG
TTCCAGAGCTGATGAGGGGTATCTTCGAACACACGAAACTTTTTCTTCTTTCATTACAG
CACACTACTCTCTAATGAGCAACGGTATACGGCCTTCTTCCAGTTACTTGAATTTGAAA
TAAAAAAGTTTGCCGCTTTGCTATCAAGTATAAATAGACCTGCAATTATTAATTTTG
TTTCTCGTCATTGTTCTCGTTCCCTTCTCTTCTTCTTCTTCTTCTGACACAATATTTCA
AGCTATACCAAGCATAACAATCAACTCCAAGCTTATGCCCAAGAAGAAGCGGAAGGTCTCG
AGCGGCGCCAATTTTAATCAAAGTGGAATATTGCTGATAGCTCATTGTCCTTCACTTTC
ACTAACAGTAGCAACGGTCCGAACCTCATAACAACTCAAACAAATTCTCAAGCGCTTTCA
CAACCAATTGCCTCCTCTAACGTTCTGATAACTTCATGAATAATGAAATCACGGCTAGT
AAAATTGATGATGGTAATAATTCAAACCACTGTACCTGGTTGGACGGACCAAACTGCG
TATAACGCGTTTTGGAATCACTACAGGGATGTTTAATACCACTACAATGGATGATGTATAT
AACTATCTATTGATGATGAAGATACCCACCAAAACCAAAAAAGAGGGTGGGTGCGATC
ACAAGTTTGTAACAAAAAGCAGGCTTGTGACCCCGGGAATTCAGATCTACTAGTGGCGC
CGCAGCGGTACCCAGCTTTCTTGTAACAAGTGGTGACGTGAGCTCCCTATAGTGAGTCG
TATTACACTGGCCGTCGTTTTTACAACGTCGTGACTGGGAAAAACCCGGTGAGCTCTAAGT
AAGTAACGGCCGCCACCGCGGTGGAGCTTTGGACTTCTTCGCCAGAGGTTTGGTCAAGTC
TCCAATCAAGGTTGTGCGGCTTGTCTACCTTGCCAGAAATTTACGAAAAGATGGAAGGG
TCAAATCGTTGGTAGATACGTTGTTGACACTTCTAAATAAGCGAATTTCTTATGATTTAT
GATTTTTATTATTAAATAAGTTATAAAAAAATAAGTGTATACAAATTTTAAAGTGACTC
TTAGGTTTTTAAACGAAAATCTTGTCTTGGAGTAACTCTTCTCTGTAGGTCAGGTTGCT
TTCTCAGGTATAGCATGAGGTGCTCTTATTGACCACACCTCTACCGGCATGCCGAGCAA
ATGCCTGCAATCGCTCCCCATTTACCCAATTGTAGATATGCTAACTCCAGCAATGAGT
TGATGAATCTCGGTGTGTATTTTATGTCCTCAGAGGACAATACCTGTTGTAATCGTTCTT
CCACACGGATCCGCATCAGGCGAAATTGTAACGTTAATATTTTGTAAATTCGCGTTA
AATATTGTTAAATCAGCTCATTTTTTAACCAATAGGCCGAAATCGGCAAAATCCCTTAT
AAATCAAAGAATAGACCGAGATAGGGTTGAGTGTGTTCCAGTTTGGAACAAGAGTCCA
CTATTAAAGAACGTGGACTCCAACGTCAAAGGGCGAAAAACCGTCTATCAGGGCGATGGC-

CCACTACGTGAACCATCACCCCTAATCAAGTTTTTTGGGGTCGAGGTGCCGTAAAGCACTA
AATCGGAACCTAAAGGGAGCCCCGATTTAGAGCTTGACGGGGAAAGCCGGCGAACGTG
GCGAGAAAGGAAGGGAAGAAAGCGAAAGGAGCGGGCGCTAGGGCGCTGGCAAGTGTAGCG
GTCACGCTGCGCGTAACCACCACCCGCGCGCTTAATGCGCCGCTACAGGGCGCGTCC
CATTGCCATTCACTGCA

FIGURE 98D

pMAB86

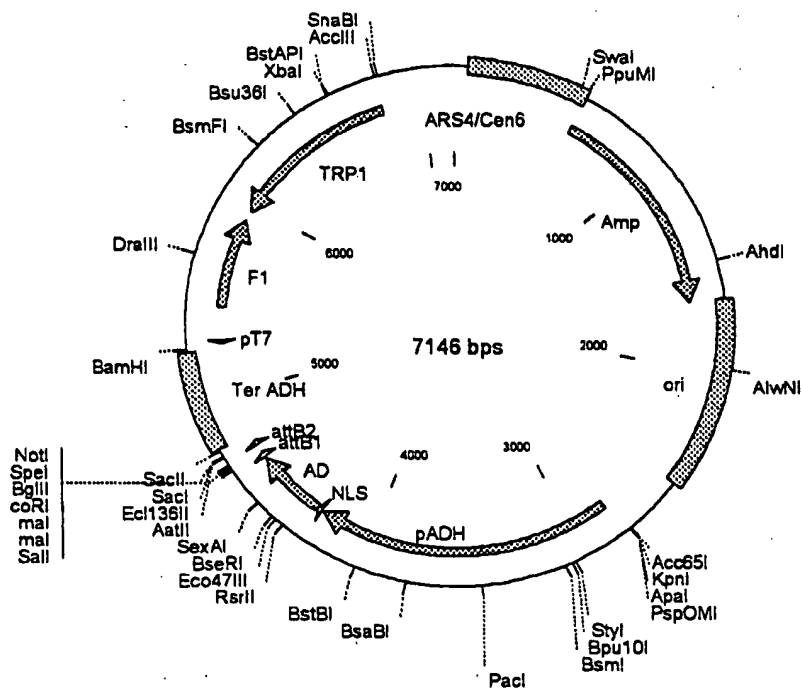


FIGURE 99A

pMAB86 7146 bp

GACGAAAGGGCCTCGTGATACGCCTATTTTTATAGGTTAATGTCATGATAATAATGGTTT
CTTAGGACGGATCGCTTGCCCTGTAACCTACACGCGCCTCGTATCTTTTAATGATGGAATA
ATTTGGGAATTTACTCTGTGTTTATTTATTTTATGTTTGTATTTGGATTTTAGAAAGT
AAATAAAGAAGGTAGAAGAGTTACGGAATGAAGAAAAAATAAACAAAGGTTTAAAAA
ATTTCAACAAAAAGCGTACTTTACATATATATTTATTAGACAAGAAAAGCAGATTAAATA
GATATACATTTCGATTAAACGATAAGTAAATGTAAATCACAGGATTTTCGTGTGTGGTCT
TCTACACAGACAAGATGAAACAATTCCGGCATTAAATACCTGAGAGCAGGAAGAGCAAGATA
AAAGGTAGTATTTGTTGGCGATCCCCCTAGAGTCTTTTACATCTTCGGAAAACAAAACT
ATTTTTTCTTTAATTTCTTTTTTTTACTTTCTATTTTTTAATTTATATATTTATATTAAAAA
ATTTAAATTATAATTATTTTTTATAGCACGTGATGAAAAGGACCCAGGTGGCACTTTTCGG
GGAAATGTGCGCGGAACCCCTATTTGTTTATTTTTCTAAATACATTCAAATATGTATCCG
CTCATGAGACAATAACCCCTGATAAATGCTTCAATAATATTGAAAAGGAAGAGTATGAGT
ATTC AACATTTCCGTGTGCGCCCTTATTTCCCTTTTTTGCGGCATTTTGCCTTCCGTGTTT
GCTCACCAGAAACGCTGGTGAAAGTAAAGATGCTGAAGATCAGTTGGGTGCACGAGTG
GGTTACATCGAAGTGGATCTCAACAGCGGTAAAGATCCTTGAGAGTTTTCGCCCCGAAGAA
CGTTTTCCAATGATGAGCACTTTTAAAGTTCTGCTATGTGGCGCGGTATTATCCCGTATT
GACGCCGGGCAAGAGCAACTCGGTGCGCCGCATACACTATTCTCAGAATGACTTGGTTGAG
TACTCACCAGTCAAGAAAAGCATCTTACGGATGGCATGACAGTAAGAGAATTATGCAGT
GCTGCCATAACCATGAGTGATAACACTGCGGCCAACTTACTTCTGACAACGATCGGAGGA
CCGAAGGAGCTAACCGCTTTTTTTCACAACATGGGGGATCATGTAACTCGCCTTGATCGT
TGGAACCGGAGCTGAATGAAGCCATACCAAACGACGAGCGTGACACCAGATGCCTGTA
GCAATGGCAACAACGTTGCGCAAACTATTAACCTGGCGAACTACTTACTCTAGCTTCCCG
CAACAATTAATAGACTGGATGGAGGCGGATAAAGTTGCAGGACCACTTCTGCGCTCGGCC
CTTCCGGCTGGCTGGTTTATTGCTGATAAATCTGGAGCCGGTGAGCGTGGGTCTCGCGGT
ATCATTGCAGCACTGGGGCCAGATGGTAAGCCCTCCCGTATCGTAGTTATCTACACGACG
GGCAGTCAGGCAACTATGGATGAACGAAATAGACAGATCGCTGAGATAGGTGCCTCACTG
ATTAAGCATTGGTAACTGTGAGACCAAGTTTACTCATATATACTTTAGATTGATTTAAAA
CTTCATTTTTTAATTTAAAAGGATCTAGGTGAAGATCCTTTTTTGATAATCTCATGACCAA
ATCCCTTAACGTGAGTTTTCGTTCCACTGAGCGTCAGACCCCGTAGAAAAGATCAAAGGA
TCTTCTTGAGATCCTTTTTTTCTGCGCGTAATCTGCTGCTTGCAAACAAAAAACACCG
CTACCAGCGGTGGTTTGTGTTGCGGATCAAGAGCTACCAACTCTTTTTCCGAAGGTAACT
GGCTTCAGCAGAGCGCAGATACCAAATCTGTCTTCTAGTGTAGCCGTAGTTAGGCCAC
CACTTCAAGAACTCTGTAGCACCGCCTACATACCTCGCTCTGCTAATCCTGTTACCAGTG
GCTGCTGCCAGTGGCGATAAGTCTGTCTTACCGGGTTGGACTCAAGACGATAGTTACCG
GATAAGGCGCAGCGGTGCGGCTGAACGGGGGGTTCGTGCACACAGCCAGCTTGGAGCGA
ACGACCTACACCGAACTGAGATACCTACAGCGTGAGCATTGAGAAAGCGCCACGCTTCCC
GAAGGGAGAAAGGCGGACAGGTATCCGGTAAGCGGCAGGGTCGGAACAGGAGAGCGCACG
AGGGAGCTTCCAGGGGGGAACGCCTGGTATCTTTATAGTCCTGTCCGGTTTTGCCACCTC
TGACTTGAGCGTCGATTTTTGTGATGCTCGTCAGGGGGGCGAGCCTATGGAAAAACGCC
AGCAACGCGGCCCTTTTACGGTTCTTGCCCTTTTGTGCTGCTTTTGTCTCACATGTTCTTT
CCTGCGTTATCCCCTGATTCTGTGGATAACCGTATTACCGCCTTTGAGTGAGCTGATACC
GCTCGCCGACGCCGAACGACCGAGCGCAGCGAGTCAGTGAGCGAGGAAGCGGAAGAGCGC
CCAATACGCAAACCGCCTCTCCCCGCGCGTTGGCCGATTCAATTAATGCAGCTGGCAGCAG
AGGTTTCCCGACTGGAAAGCGGGCAGTGAGCGCAACGCAATTAATGTGAGTTACCTCACT
CATTAGGCACCCAGGCTTTTACACTTTATGCTTCCGGCTCCTATGTTGTGTGGAATTGTG
AGCGGATAACAATTTACACAGGAAACAGCTATGACCATGATTACGCCAAGCTCGGAATT
AACCCTCACTAAAGGGAACAAAAGCTGGGTACCGGGCCCCCCTCGAGATCCGGGATCGA
AGAAATGATGGTAAATGAAATAGGAAATCAAGGAGCATGAAGGCAAAAGACAAATATAAG
GGTCGAACGAAAAATAAAGTGAAGAGTGTGATATGATGTATTTGGCTTTGCGGCGCCGA
AAAAACGAGTTTACGCAATTGCACAATCATGTGACTCTGTGGCGACCCGCGCTCTTGC
CGGCCCCGGGATAACGCTGGGCGTGAGGCTGTGCCCCGCGGAGTTTTTTGCGCCTGCATT
TTCCAAGGTTTACCCTGCGCTAAGGGGCGAGATTGAGAGAAGCAATAAGAATGCCGGTTGG
GGTTGCGATGATGACGACCACGACAACCTGGTGTCAATTATTTAAGTTGCCGAAAGAACCTG
AGTGCATTTGCAACATGAGTATACTAGAAGAATGAGCCAAGACTTGCGAGACGCGAGTTT
CGCGGTGGTGCAACAATAGAGCGACCATGACCTTGAAGGTGAGACGCGCATAACCGCTA-

FIGURE 99B

GAGTACTTTGAAGAGGAAACAGCAATAGGGTTGCTACCAGTATAAATAGACAGGTACATA
CAACACTGGAAATGGTTGTCTGTTTGAGTACGCTTTCAATTCAATTGGGGTGTGCACCTTTA
TTATGTTACAATATGGAAGGGAACTTTACACTTCTCCTATGCACATATATTAATTAAAGT
CCAATGCTAGTAGAGAAGGGGGGTAACACCCCTCCGCGCTCTTTTCCGATTTTTTTCTAA
ACCGTGGAATATTCGGATATCCTTTTGTGTTTCCGGGTGTACAATATGGACTTCCTCT
TTTCTGGCAACCAAACCCATACATCGGGATTCTTATAATACCTTCGTTGGTCTCCCTAAC
ATGTAGGTGGCGGAGGGAGATATACAATAGAACAGATACCAGACAAGACATAATGGGCT
AAACAAGACTACACCAATTACACTGCCTCATTGATGGTGGTACATAACGAACTAATACTG
TAGCCCTAGACTTGATAGCCATCATCATATCGAAGTTTCACTACCCTTTTTCCATTTGCC
ATCTATTGAAGTAATAATAGGCGCATGCAACTTCTTTTCTTTTTTTTTCTTTCTCTCTC
CCCCGTTGTTGTCTCACCATATCCGCAATGACAAAAAATGATGGAAGACACTAAAGGA
AAAAATTAACGACAAAGACAGCACCAACAGATGTCGTTGTTCCAGAGCTGATGAGGGGTA
TCTTCGAACACACGAACTTTTTCTTCTTTCATTACGCACACTACTCTCTAATGAGCA
ACGGTATACGGCCTTCCTTCCAGTTACTTGAATTTGAAATAAAAAAGTTTGCCGCTTTG
CTATCAAGTATAAATAGACCTGCAATTATTAATCTTTTGTTCCTCGTCATTGTTCTCGT
TCCCTTTCTTCTTGTGTTCTTTTCTGCAATATTTCAAGCTATACCAAGCATACAATC
AATCCCAAGCTTATGCCCAAGAAGAAGCGGAAGGTCTCGAGCGGCGCAATTTTAATCAA
AGTGGGAATATTGCTGATAGCTCATTGTCTTCACTTTCACTAACAGTAGCAACGGTCCG
AACCTCATAACAACCTCAAACAATTCTCAAGCGCTTTCACAACCAATTGCCTCCTCTAAC
GTTTCATGATAACTTCATGAATAATGAAATCACGGCTAGTAAAATTGATGATGGTAATAAT
TCAAAACCACTGTCACCTGGTTGGACGGACCAACTGCGTATAACGCGTTTGAATCACT
ACAGGGATGTTTAATACCACTACAATGGATGATGTATATACTATCTATTGATGATGAA
GATACCCACCAAACCCAAAAAAGAGGGTGGGTGCGATCACAAGTTTGTACAAAAAGCA
GGCTTGTGCGACCCCGGAATTGAGATCTACTAGTGCAGCGCCGACGCGTACCCAGCTTTCT
TGTACAAAGTGGTGACGTGAGCTCTAAGTAAGTAACGGCCGCCACCGCGGTGGAGCTTT
GGACTTCTTCCGAGAGGTTTGGTCAAGTCTCAATCAAGGTTGTCGGCTTGTCTACCTT
GCCAGAAATTTACGAAAAGATGGAAAAGGGTCAAATCGTTGGTAGATACGTTGTTGACAC
TTCTAAATAAGCGAATTTCTTATGATTTATGATTTTTATTATTAATAAGTTATAAAAAA
AATAAGTGTATACAAATTTTAAAGTGAATCTTAGGTTTAAAACGAAAATCTTGTCTT
GAGTAACTCTTTCCTGTAGGTGAGGTTGCTTTCTCAGGTATAGCATGAGGTCGCTCTTAT
TGACCACACCTCTACCGGCATGCCGAGCAAATGCCTGCAAATCGCTCCCCATTTACCCCA
ATTGTAGATATGCTAACTCCAGCAATGAGTTGATGAATCTCGGTGTGTATTTTATGTCCT
CAGAGGACAATACCTGTTGTAATCGTTCTTCCACACGGATCCCAATTCGCCCTATAGTGA
GTCGTATTACAATTCAGTGGCCGTCGTTTACAACGTCGTGACTGGGAAAACCTTGGCGT
TACCCAACTTATCGCCTTGACGACATCCCCCTTTCGCCAGCTGGCGTAATAGCGAGA
GGCCCGCACCGATCGCCCTTCCCAACAGTTGCGCAGCCTGAATGGCGAATGGACGCGCCC
TGTAGCGGCGCATTAAGCGCGGCGGGTGTGGTGGTTACGCGCAGCGTGACCGCTACACTT
GCCAGCGCCCTAGCGCCCGCTCCTTTCGCTTTCTTCCCTTCTTTCTCGCCACGTTCCGCC
GGCTTTCCCGTCAAGCTCTAAATCGGGGGCTCCCTTTAGGGTTCCGATTTAGTGCTTTA
CGGCACCTCGACCCCAAAAACTTGATTAGGGTGATGGTTACGTAAGTGGGCCATCGCCC
TGATAGACGGTTTTTTCGCCCTTTGACGTTGGAGTCCACGTTCTTTAATAGTGGACTCTTG
TTCCAACTGGAACAACACTCAACCTATCTCGGTCTATTCTTTTGATTTATAAGGGATT
TTGCCGATTTGGCCCTATTGGTTAAAAAATGAGCTGATTTAACAAAAATTTAACGCGAAT
TTTAACAAAATATTAACGTTTACAATTTCTGATGCGGTATTTTCTCCTTACGCATCTGT
GCGGTATTTACACCGCAGGCAAGTGACAAACAATACTTAATAAATACTACTCAGTAA
TAACCTATTTCTTAGCATTTTGTACGAAATTTGCTATTTTGTAGAGTCTTTTACACCAT
TTGTCTCCACACCTCCGCTTACATCAACACCAATAACGCCATTTAATCTAAGCGCATCAC
CAACATTTTCTGGCGTCAGTCCACCAGCTAACATAAAATGTAAGCTTTCCGGGCTCTCTT
GCCTTCCAACCCAGTCAGAAATCGAGTTCCAATCCAAAAGTTACCTGTCCACCTGCTT
CTGAATCAAACAAGGGAATAAACGAATGAGGTTTCTGTGAAGCTGCACTGAGTAGTATGT
TGCAGTCTTTTGGAAATACGAGTCTTTTAATAACTGGCAAACCGAGGAACCTTTGGTATT
CTTGCCACGACTCATCTCCATGCAGTTGGACGATATCAATGCCGTAATCATTGACCAGAG
CCAAACACTCTCTTAGGTTGATTACGAAACGCAACCAAGTATTTCCGAGTGGCCTG
AACTATTTTTATAGCTTTTACAAGACTTGAAATTTTCTTGCATAACCGGGTCAATTG
TTCTCTTTCTATTGGGCACACATATAATACCCAGCAAGTCAGCATCGGAATCTAGAGCAC
ATTCTGCGGCCTCTGTGCTCTGCAAGCCGCAAACTTTACCAATGGACCAGAACTACCTG
TGAAATTAATAACAGACATACTCAAGCTGCCTTTGTGTGCTTAATCACGTATACTCACG
TGCTCAATAGTCACCAATGCCCTCCCTCTTGGCCCTCTCCTTTCTTTTTTTCGACCGAAT-

TAATTCTTAATCGGCAAAAAAAGAAAAGCTCCGGATCAAGATTGTACGTAAGGTGACAAG
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ACATATATTACGATGCTGTCTATTAAATGCTTCCTATATTATATATATAGTAATGTCGTT
TATGGTGCACTCTCAGTACAATCTGCTCTGATGCCGCATAGTTAAGCCAGCCCCGACACC
CGCCAACACCCGCTGACGCGCCCTGACGGGCTTGTCTGCTCCCGGCATCCGCTTACAGAC
AAGCTGTGACCGTCTCCGGGAGCTGCATGTGTCAGAGGTTTTACCGTCATCACCGAAAC
GCGCGA

FIGURE 99D

INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

REC'D

A. The indications made below relate to the microorganism referred to in the description on page <u>54</u> , line <u>8</u>	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depositary Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30103
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB3.1(pEZC15101) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")	

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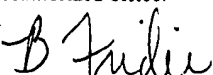
INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>55</u> , line <u>16</u> .	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depository Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30100
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB3.1(pENTR-1A) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")	

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INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>55</u> , line <u>16</u> .	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depository Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30102
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB3.1(pENTR-3C) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")	

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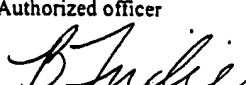
INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>55</u> , line <u>16</u> .	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depository Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30101
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB3.1(pENTR-2B) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")	

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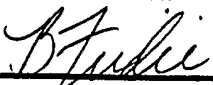
INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>20-21</u> .	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depository Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30108
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB10B(pCMVSPORT6) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")	

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INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>54</u> , line <u>9</u> .	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depository Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30105
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB3.1(pEZC15103) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")	

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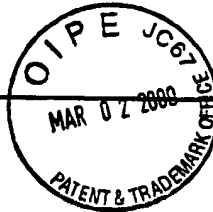
INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>54</u> , line <u>9</u> .	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depository Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30104
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB3.1(pEZC15102) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit")	

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INDICATIONS RELATING TO A DEPOSITED MICROORGANISM
(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>52</u> , line <u>31</u> .	
B. IDENTIFICATION OF DEPOSIT Further deposits are identified on an additional sheet <input checked="" type="checkbox"/>	
Name of depositary institution Agricultural Research Culture Collection (NRRL) International Depository Authority	
Address of depositary institution (including postal code and country) 1815 N. University Street Peoria, Illinois 61604 United States of America	
Date of deposit February 27, 1999	Accession Number NRRL B-30099
C. ADDITIONAL INDICATIONS (leave blank if not applicable) This information is continued on an additional sheet <input type="checkbox"/>	
Escherichia coli DB3.1(pAHPKan) or Escherichia coli DB3.1(pAttPKan) In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication of the mention of the grant of the European patent or until the date on which the application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the international Bureau later (specify the general nature of the indications, e.g., "Accession Number of Deposit") 	



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Escherichia coli DB3.1(pENTR-3C)**ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegian Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent office or any person approved by the applicant in the individual case.

SINGAPORE

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

*Escherichia coli DB3.1(pENTR-3C)***SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pENTR-2B)**AUSTRALIA**

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

CANADA

The applicant hereby requests that, until either a Canadian patent has been issued on the basis of the application or the application has been refused, or is abandoned and no longer subject to reinstatement, or is withdrawn, the furnishing of a sample of deposited biological material referred to in the application only be effected to an independent expert nominated by the Commissioner of Patents.

DENMARK

The applicant hereby requests that, until the application has been laid open to public inspection (by the Danish Patent Office), or has been finally decided upon by the Danish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Danish Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Danish Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Danish Patent office or any person approved by the applicant in the individual case.

FINLAND

The applicant hereby requests that, until the application has been laid open to public inspection (by the National Board of Patents and Registration), or has been finally decided upon by the National Board of Patents and Registration without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the National Board of Patents and Registration or any person approved by the applicant in the individual case.

Escherichia coli DB3.1(pENTR-2B)**ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegian Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent office or any person approved by the applicant in the individual case.

SINGAPORE

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pENTR-2B)**SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pENTR-1A)**AUSTRALIA**

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

CANADA

The applicant hereby requests that, until either a Canadian patent has been issued on the basis of the application or the application has been refused, or is abandoned and no longer subject to reinstatement, or is withdrawn, the furnishing of a sample of deposited biological material referred to in the application only be effected to an independent expert nominated by the Commissioner of Patents.

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FINLAND

The applicant hereby requests that, until the application has been laid open to public inspection (by the National Board of Patents and Registration), or has been finally decided upon by the National Board of Patents and Registration without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the National Board of Patents and Registration or any person approved by the applicant in the individual case.

Escherichia coli DB3.1(pENTR-1A)**ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegian Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent office or any person approved by the applicant in the individual case.

SINGAPORE

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Escherichia coli DB3.1(pENTR-1A)**SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

*Escherichia coli DB10B(pCMVSPORT6)***AUSTRALIA**

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

CANADA

The applicant hereby requests that, until either a Canadian patent has been issued on the basis of the application or the application has been refused, or is abandoned and no longer subject to reinstatement, or is withdrawn, the furnishing of a sample of deposited biological material referred to in the application only be effected to an independent expert nominated by the Commissioner of Patents.

DENMARK

The applicant hereby requests that, until the application has been laid open to public inspection (by the Danish Patent Office), or has been finally decided upon by the Danish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Danish Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Danish Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Danish Patent office or any person approved by the applicant in the individual case.

FINLAND

The applicant hereby requests that, until the application has been laid open to public inspection (by the National Board of Patents and Registration), or has been finally decided upon by the National Board of Patents and Registration without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the National Board of Patents and Registration or any person approved by the applicant in the individual case.

Escherichia coli DB3.1(pAHPKan) or *Escherichia coli* DB3.1(pAttPKan)

AUSTRALIA

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

CANADA

The applicant hereby requests that, until either a Canadian patent has been issued on the basis of the application or the application has been refused, or is abandoned and no longer subject to reinstatement, or is withdrawn, the furnishing of a sample of deposited biological material referred to in the application only be effected to an independent expert nominated by the Commissioner of Patents.

DENMARK

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FINLAND

The applicant hereby requests that, until the application has been laid open to public inspection (by the National Board of Patents and Registration), or has been finally decided upon by the National Board of Patents and Registration without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the National Board of Patents and Registration or any person approved by the applicant in the individual case.

Escherichia coli DB3.1(pAHPKan) or Escherichia coli DB3.1(pAttPKan)

ICELAND

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegian Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent office or any person approved by the applicant in the individual case.

SINGAPORE

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pAHPKan) or Escherichia coli DB3.1(pAttPKa λ)

SWEDEN

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

*Escherichia coli DB10B(pCMVSPORT6)***ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegian Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent office or any person approved by the applicant in the individual case.

SINGAPORE

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

*Escherichia coli DB10B(pCMVSPORT6)***SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pEZC15103)**AUSTRALIA**

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

CANADA

The applicant hereby requests that, until either a Canadian patent has been issued on the basis of the application or the application has been refused, or is abandoned and no longer subject to reinstatement, or is withdrawn, the furnishing of a sample of deposited biological material referred to in the application only be effected to an independent expert nominated by the Commissioner of Patents.

DENMARK

The applicant hereby requests that, until the application has been laid open to public inspection (by the Danish Patent Office), or has been finally decided upon by the Danish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Danish Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Danish Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Danish Patent office or any person approved by the applicant in the individual case.

FINLAND

The applicant hereby requests that, until the application has been laid open to public inspection (by the National Board of Patents and Registration), or has been finally decided upon by the National Board of Patents and Registration without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the National Board of Patents and Registration or any person approved by the applicant in the individual case.

Escherichia coli DB3.1(pEZC15103)**ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegian Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent office or any person approved by the applicant in the individual case.

SINGAPORE

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pEZC15103)**SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pEZC15102)**AUSTRALIA**

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

CANADA

The applicant hereby requests that, until either a Canadian patent has been issued on the basis of the application or the application has been refused, or is abandoned and no longer subject to reinstatement, or is withdrawn, the furnishing of a sample of deposited biological material referred to in the application only be effected to an independent expert nominated by the Commissioner of Patents.

DENMARK

The applicant hereby requests that, until the application has been laid open to public inspection (by the Danish Patent Office), or has been finally decided upon by the Danish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Danish Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Danish Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Danish Patent office or any person approved by the applicant in the individual case.

FINLAND

The applicant hereby requests that, until the application has been laid open to public inspection (by the National Board of Patents and Registration), or has been finally decided upon by the National Board of Patents and Registration without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the National Board of Patents and Registration or any person approved by the applicant in the individual case.

Escherichia coli DB3.1(pEZC15102)**ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegian Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent office or any person approved by the applicant in the individual case.

SINGAPORE

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

*Escherichia coli DB3.1(pEZC15102)***SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pEZC15101)**AUSTRALIA**

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CANADA

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FINLAND

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Escherichia coli DB3.1(pEZC15101)**ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

NETHERLANDS

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapsed, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever of the two dates occurs earlier.

NORWAY

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SINGAPORE

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pEZC15101)**SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PCT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent office or any person approved by the applicant in the individual case.

UNITED KINGDOM

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

Escherichia coli DB3.1(pENTR-3C)**AUSTRALIA**

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

CANADA

The applicant hereby requests that, until either a Canadian patent has been issued on the basis of the application or the application has been refused, or is abandoned and no longer subject to reinstatement, or is withdrawn, the furnishing of a sample of deposited biological material referred to in the application only be effected to an independent expert nominated by the Commissioner of Patents.

DENMARK

The applicant hereby requests that, until the application has been laid open to public inspection (by the Danish Patent Office), or has been finally decided upon by the Danish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Danish Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Danish Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Danish Patent office or any person approved by the applicant in the individual case.

FINLAND

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A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : Please See Extra Sheet.

US CL : 435/91.2, 252.3, 320.1; 530/350; 536/ 23.1, 24.1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 435/91.2, 252.3, 320.1; 530/350; 536/ 23.1, 24.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P ---- Y,P	US 5,888,732 A (HARTLEY et al.) 30 March 1999, see entire document.	1-21, 25-30 36-38 ----- 22-24, 31-35
X - Y	HASAN et al. Escherichia coli genome targeting, I. Cre-lox-mediated in vitro generation of ori- plasmids and their in vivo chromosomal integration and retrieval. Gene. 1994, Vol. 150, pages 51-56, see entire document.	1-5, 10, 11, 19-21 ----- 15-18, 22-38
X - Y	KATZ et al. Site-specific recombination in Escherichia coli between the att sites of plasmid pSE211 from Saccharopolyspora erythraea. Mol. Gen. Genet. 1991, Vol. 227, pages 155-159, see entire document.	1-11, 19-21 ----- 15-18, 22-38

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

08 MAY 2000

Date of mailing of the international search report

23 MAY 2000

 Name and mailing address of the ISA/US
 Commissioner of Patents and Trademarks
 Box PCT
 Washington, D.C. 20231

Facsimile No. (703) 305-3230

 Authorized officer
Christina Lawrence Fox
 IREM YUCEL

Telephone No. (703) 308-0196

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X - Y	ASTUMIAN et al. Site-specific recombination between cloned attP and attB sites from the Haemophilus influenzae bacteriophage HP1 propagated in recombination deficient Escherichia coli. J of Bacteriology. March 1989, Vol. 171, No. 3, pages 1747-1750, see entire document.	1-11, 19-21 ----- 15-18, 22-38

A. CLASSIFICATION OF SUBJECT MATTER:

IPC (7):

C07H 21/04; C07K 1/00, 14/00; C12N 1/21, 15/00, 15/09, 15/63, 15/70; C12P 19/34

B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

WEST, STN (CAPLUS); DIALOG (MEDLINE, BIOSIS, SCISEARCH, PASCAL)

Terms: att (B?, P?, R?, L?), MCS, POLYLINKER, PLASMID, VECTOR, LOCALIZATION, SIGNAL, TRANSCRIPTION, TERMIN?, TRANSLATION?, ORI, REPLICON, GST, HEXHIST?, THIOREDOX?, CLEAVAGE, SITE?, SPECIF?, DIRECT?, RECOMBIN?, CLON?, INSERT?